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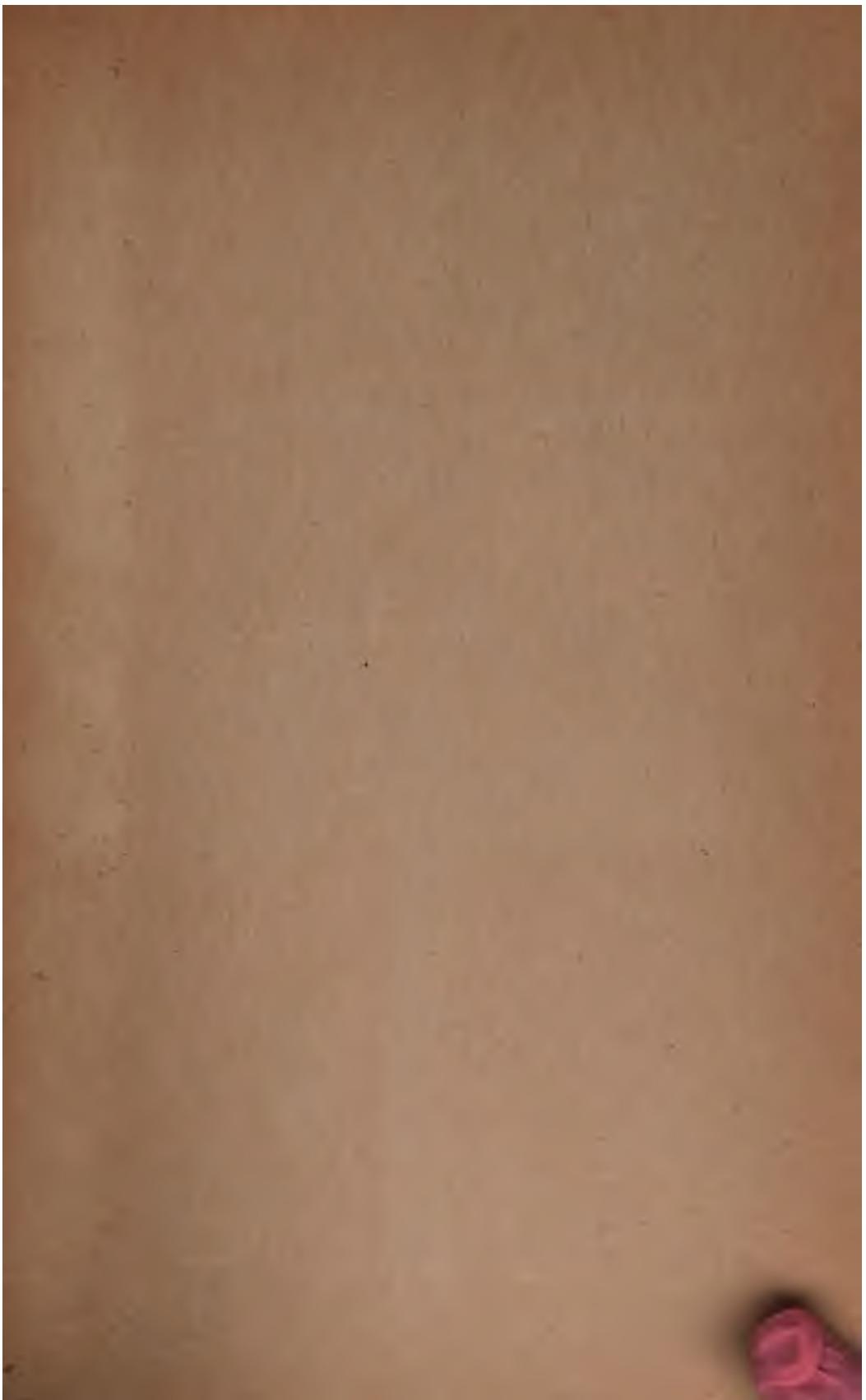
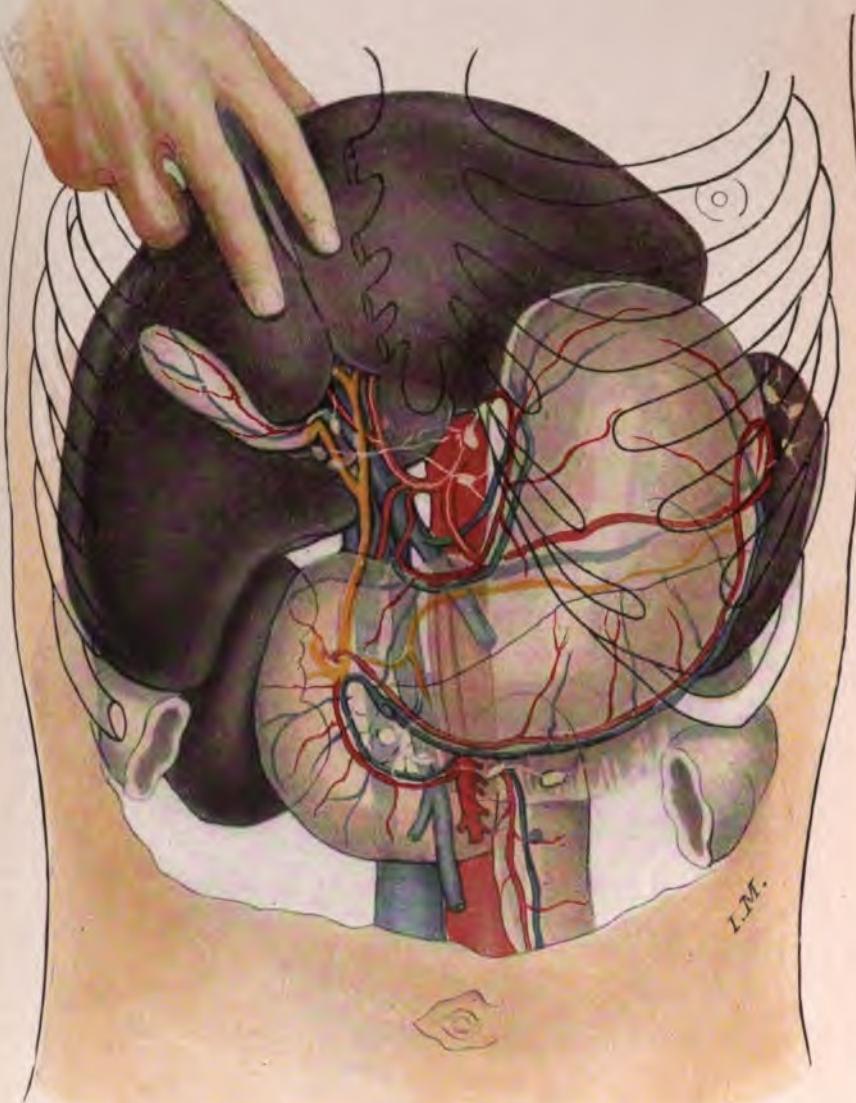






PLATE I.



Showing the relation of the stomach to surrounding organs. Front of liver  
is raised so that under structures may be seen.

# DISEASES OF THE DIGESTIVE SYSTEM

BY

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**VOLUME ONE**  
**THE STOMACH AND UPPER ALIMENTARY TRACT**

**FIFTH EDITION, REVISED AND ENLARGED**

**Illustrated with 151 Half-tone and Line Text Engravings and 93 Full-page Plates (with 164 Figures) Plain and in Colors, from Original Photographs and Drawings**



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TO THE  
**PRACTITIONERS OF MEDICINE**  
I RESPECTFULLY DEDICATE  
THIS VOLUME.  
**OPTIMI AMICI HUMANI GENERIS**

**80004**

(iii)

## PREFACE TO FIRST EDITION.

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IN the advancing of this volume it is not the purpose of the author to assist in the erroneous movement of divorcing the diseases of the stomach and upper alimentary tract from the field of internal medicine to which it rightfully belongs. Nor does he wish to approach the consideration of gastro-enterology by including it in the broader field, and thus add to these pages all of the subject matter found in text-books on the Principles and Practice of Medicine. In these more scientific days of our profession, ardent workers in the fields of physiology and nosology of the alimentary canal have elucidated much of practical value. My observations have coincided with some and been at variance with others; my experiences and thoughts have led me along a few modest lines of my own, and these, with some new personal contributions herein incorporated, and the desire to write a scientific and handy work for the busy general practitioner of medicine, a book which is practical rather than charged with the discussions and the theories of different observers, are my reasons for the offering of this treatise.

To-day, the internist must recognize the fact that the wealth of detail necessary to bring the advances that have been made in this field of medicine to their best practical results means clinical observation, much laboratory labor, experience in the way of special technique in the examination and treatment of these conditions; a knowledge of practical chemistry, physiology, physiological chemistry, morbid histology and bacteriology; the medical uses of special drugs, baths, waters, and electricity; the indications for surgery, some skill in the mechanical way, and so on. In the modern practice of caring for these diseases it requires more time than can usually be given to it by the busy physician who is engaged more generally, and thus is established, only to a degree, the propriety of this creed of internal medicine which is so indissolubly connected with the broader field that it can never be established as a branch apart as other departments are. to-day.

Important indeed is it for one engaged in gastro-enterology to be versed in internal medicine and pathology, and it is the author's firm conviction that anyone who intends limiting his practice to this



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Important indeed is it for one engaged in gastro-enterology to be versed in internal medicine and pathology, and it is the author's firm conviction that anyone who intends limiting his practice to this

field alone should first engage for some years in observation and experience in general medicine, or internal medicine at least. Because of the complexity of the work, unless he has had this broadening experience, the degree of success in his results will be seriously handicapped. To one doing much gastric work this is a fact that recalls itself each day to the broad minded observer.

To be able to make an early diagnosis of gastric carcinoma before the tumor is palpable from without, a possibility that comes in the work now and then; the diagnosis and beneficent results obtained in the treatment of the chronic gastritides; motor, secretory, and sensory disturbances of the stomach; conditions of the orifices; ulcers and so on, not to mention the still more ample field of the enteric tract with its accessory organs is worthy of a life's study. The privilege of life is short in years, experience is often fallacious, and in medicine much of the grain of practical worth is served with the chaff.

It is also true that the gastro-enterologist should observe concerning the dyspeptic who has walked into his office or clinic, and whose case proves to belong to the category of the circulatory, respiratory, renal, nervous, infectious, blood, lymphatic, muscular or constitutional diseases, that there may be other hands more skilled than his are in at least the therapy of these conditions, and into these hands such a case might best be delivered. With the mutual understanding and observance of this, the gastro-enterologist's work can go on pleasantly as a specialty of internal medicine about as neurology is to-day, and in this way greater benefit can be brought to a patient and the noble art of medicine advanced.

ANTHONY BASSLER.

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muscles which are contained entirely within the tongue and form its greatest bulk (intrinsic). The posterior fibers of the geniohyoglossi muscles draw the tongue forward so as to protrude the apex from the mouth, and the anterior fibers draw it back again. The whole length of these fibers acting together depress the center of the organ forming the channel along which fluids pass backward in the act of sucking. The hyoglossi depress the tongue and draw down its margin rendering it convex from side to side. The styloglossi draw the tongue upward and backward, and the palatoglossi draw the base upward. The intrinsic muscles make possible the various smaller movements of the organ itself, completing the equipment for its functions in mastication and in the production of voice.

The vessels of the tongue are the arteries derived from the lingual, facial and ascending pharyngeal. The veins accompany these. The glands are the mucous, which are distributed over the surface of the mucous membrane, and resemble the labial and buccal; the serous, which are found in the back of the tongue and empty a water secretion near the taste-goblets and into the fossæ of the circumvallate papillæ; and the lymphoid follicles, which are found mostly in the space between the epiglottis and the circumvallate papillæ.

The nerves of the tongue are the hypoglossal and the inferior lingual branch of the chorda tympani. Sympathetic filaments pass from the nervi molles on the lingual and the other arteries that supply it.

The special nerves are the lingual branch of the glossopharyngeal (ninth cranial), and the lingual nerve, a branch of the inferior maxillary (fifth cranial). The lingual supplies the anterior two-thirds of the mucous membrane of the tongue, the glossopharyngeal the posterior one-third. The taste-fibers are carried in these two nerves. In the case of the lingual they are derived from the chorda tympani, which is a branch of the seventh cranial. These nerves will be described more in detail in connection with the sense of taste.

The structures covering the tongue are peculiar to the organ. On the under surface is the continuation of the thin, smooth structure that lines the rest of the oral cavity. That on the dorsum, in addition, consists of a layer of connective tissue (corium) which supports the papillæ and over which is a scaly, tough variety of epithelium. In this connective tissue are found many vessels and nerves supplying the papillæ together with large plexuses of lymphatic vessels and glands.

The papillæ are cone-shaped projections of the corium containing one or more capillary loops amongst which are distributed nerves in

great abundance. According to their configuration they are designated as the circumvallate, fungiform and filiform. The circumvallate papillæ, from eight to twelve in number, are situated at the back of the dorsum of the tongue in a single row, obliquely arranged on each side so as to meet in the middle line, the apex being made up by the largest papilla of the group. They are about  $\frac{1}{15}$  of an inch wide and surrounding them is a cup-shaped depression of mucous membrane. The fungiform papillæ are more numerous than the preceding and are scattered discretely and irregularly over the sides and dorsum. They are normally of a deeper color (due to their thin epithelial coating and vascularity), and further can easily be distinguished from the small variety by their larger size and shape (fungiform). Occasionally, when the tongue is moderately coated so that the filiform variety cannot be seen, the fungiforms stand out as deep red spots. The filiforms are generally distributed over the anterior two-thirds of the tongue. They are very small, are arranged in rows, and have numerous filiform processes projecting from their apices which are of a somewhat whitish tint.

Buried in the epidermis of the circumvallate papillæ and in some of the fungiforms, as well as elsewhere about the mouth, epiglottis and larynx, are the taste-buds which are generally recognized as the end-organs of the taste-fibers. These curious structures are oval bodies with an external layer of tegumental cells, and they contain in the interior a number of elongated cells each of which ends in a hair-like process which projects through the central pore to the free surface. These cells may be considered the true sense-cells and the ciliated ends, no doubt, act in some way to convey stimulation to them. When the cells are thus aroused, they affect the taste-fibers of the nerves which terminate in filaments around them.

**The Teeth.**—Among the mammalia, and particularly in man, the teeth are developed in two sets; the temporary or milk teeth, ten in each jaw; and the permanent teeth, thirty-two in number, also equally divided above and below. As the temporary teeth are not of much significance in this connection, and are lost in early life, they will not be considered.

A full set of permanent teeth in each jaw consists of the four incisors, called so because they divide the food; the two canines, larger in size, so named because they resemble like teeth in the dog; the four premolars or bicuspids, named thus because of their position in front of the molars or from the fact that they have two cusps to assist in the cutting and grinding of the food; and the six molars, which are larger than the others, and which comminute the food.

Each tooth consists of a crown and root with the neck between. The bulk of the tooth is made up of a bone-like substance called dentine through which run numberless tubules from the covering of the crown (enamel) and the cement investment of the root (*crusta petrosa*) to the pulp cavity in the center of it. Through these exceedingly small canals ( $\frac{1}{4500}$  of an inch in diameter) circulate the fluids that nourish the tooth. In the live tooth this circulation is carried on outwards from the pulp, which consists of connective tissue richly supplied with nerves and vessels; and in the so-called dead tooth only from the cementum inwards.

The enamel covering the crown is the hardest substance in the human body. It is thickest on the grinding surface and consists of a congeries of minute hexagonal rods (about  $\frac{1}{6000}$  of an inch in diameter) which lie parallel with one another. The cement covers the fang of the tooth, gradually becoming thicker toward its extremity. It contains lacunæ and canaliculi like bone. Externally it is covered by the dental periosteum which supplies it and the tooth-substance with nutrition and serves to fasten it in the receptive spaces in the alveolar processes of the maxillary bones in which the teeth are held. In old age the cement increases in thickness, becomes irregular, and further conversion-changes in the dentine and pulp may fill up the pulp cavity with a hard substance which is intermediate in structure between dentine and bone.

The gums are composed of a dense fibrous tissue, closely attached to the periosteum of the alveolar processes, and surround the necks of the teeth. They are covered with a smooth, very vascular mucous membrane, which is remarkable for its limited sensibility.

Because of the importance of the teeth in the process of digestion it would not be amiss, in this connection, to spend a few moments on a few practical considerations of them from a dental standpoint.

The common and most destructive disease of the teeth is caries. It may be confined to one or more teeth as a slow process, but it may also involve every one of them at about the same time and be rapid in its course. It usually begins on the side of the dentine at the site of some imperfect point in the enamel, and it proceeds inward toward the center of the tooth in an enlarging cone-shaped progress. No portion of the crown or neck of the tooth is exempt from this disease which, if unchecked, usually destroys the entire crown leaving the root intact. In well-formed, firm teeth the process is slow, and *vice versa*. The profuse administration of mercury, the continued fevers, and all severe acquired and hereditary constitutional disorders are predisposing causes to this decay. The exciting causes are the agents which chemically disintegrate the enamel and dentine. These are derived from the abnormal secretions of the stomach (acids), saliva, mucus and the decomposition of animal and vegetable foods

in the mouth, certain vegetable acids in foods and drink (cetric, malic, acetic), medicines containing free mineral acids, and the fungi and organisms of the mouth. To prevent caries the teeth and mouth should be kept clean by washing after the meals, by freeing them from calcareous deposits, keeping the gums healthy and the secretions of the mouth normal in character by the use of a brush, waxed floss silk and an alkaline dentifrice. Carious spots should be recognized early, the cavity cleaned out and properly filled with suitable material by a dentist.

When the permanent teeth begin to erupt it should be observed that they come in regularly and in proper alignment. Here an experienced and painstaking dentist can do much good work in correcting irregularities by mechanically encouraging growth in various directions.

The diseases of the gums, such as sponginess, gingivitis, Rigg's disease, tumefactions, chronic inflammations, and simple ulcerations should be taken in hand early and cared for.

From the canines back to the end molars, wherever a space exists from the loss of one or more teeth, artificial teeth should be installed either as caps, bridge or plate work. The teeth in the sides of the jaws are used for the grinding of the foods in mastication, and unless the alignment of them is complete and there are corresponding teeth above and below to coaptate, the comminution and insalivation of foods may not be sufficient for comfortable digestion. The loss of teeth and the absorption of the alveolar process of the inferior maxilla make this a common cause of gastric disturbance in the aged.

The salivary glands are three in number on each side—the parotid, the submaxillary, and the sublingual. They are of the compound tubular variety. The parotid is the largest of the three on each side, and it lies immediately below and in front of the external ear communicating with the mouth by a large-sized duct (Stenson's duct) which runs directly forward from the gland and opens on the buccal side of the cheek opposite the second molar tooth of the upper jaw. The gland weighs about three-quarters of an ounce, and its secreting epithelium is composed of cells which contain numerous fine granules. Its secretion is thin and contains considerable serum-albumin.

The submaxillary gland is situated below the lower jaw in the anterior part of the submaxillary triangle of the neck. It weighs about two drams and its duct (Wharton's duct) opens into the mouth cavity at the side of the frenum of the tongue. Its secretion is thicker than that of the parotid, containing more mucus.

The sublingual is the smallest of the salivary glands. It is situated immediately beneath the mucous membrane of the floor of the mouth at the side of the frenum linguæ. It is almond-shaped and weighs about 4 grams. It opens into the mouth cavity by from eight to twenty separate small ducts (ducts of Rivini) one or more of which opens into the duct of the submaxillary (duct of Bartholin).

Its secretion contains much mucus and is the thickest of the three true salivary glands; this is no doubt due to the presence in the gland of a predominance of the mucus-secreting cells.

In addition to the salivary glands numerous other small-sized glands are found in the mouth. They are scattered on the posterior part of the dorsum of the tongue back of the circumvallate papillæ, at the margins of the tongue, in the tonsils, soft palate and in the buccal walls and lips. They secrete mucus which keeps the mouth moist during the intervals of mastication, and which when mixed with the salivary secretion assists in swallowing. Those, however, which open into the trenches about the circumvallate papillæ secrete a more watery fluid, which Ebner believes assists in the sense of taste at this point.

The salivary glands possess definite secretory nerves which are derived from the chorda tympani (Ludwig). These fibers terminate in a plexus upon the membrana propria of the alveoli, and from this plexus fine fibers pass to the secreting cells. These nerves probably also carry filaments from the sympathetic.

The cells of both the albuminous and mucous glands undergo histological changes during activity. According to Langley, when in a fasting condition the cells have a granular appearance throughout their structure and the border lines of the different cells are faintly marked with light lines. When the gland secretes, the granules begin to disappear from the edges of the cells, so that each cell shows an outer clear and an inner granular zone. If the stimulation continues the clear zone increases in extent and the cells become smaller. It is assumed that the granules are employed in some preparatory way to make the main organic constituent of the secretion (ptyalin), and that these granules form in the resting glands during the intervals of salivary discharge; thus they are spoken of as zymogen granules.

The cells in the mucous glands also undergo a change during secretion. In stained sections of the resting gland the cells are large and clear with flattened nuclei near the base of the cell body. When the glands are made to secrete, the nuclei become more spherical and lie more toward the middle of the cell, while the cells themselves become distinctly smaller. Langley has shown that the cells of the submaxillary glands contain numerous large granules. As these granules can be favorably compared with those in the mucus-secreting goblet-cell it can be inferred that they consist of mucin, or some preparatory substance, which is extruded from the cells and glands during secretion.

**PHARYNX AND ESOPHAGUS.**

The pharynx is the musculo-membranous, funnel-shaped sac, larger above than below, that extends from the under surface of the skull to the esophagus, which it joins at the cricoid cartilage in front of the level of the sixth cervical vertebra. In the adult it is about four and a half inches long, and is widest in its transverse diameter. It is composed of three coats, of which the internal mucous is soft, red and contains many mucous glands. This membrane is continuous above with that lining the Eustachian tubes and the posterior nares, and is covered by ciliated columnar epithelium. Below the nares, however, this epithelium abruptly changes in character into the squamous form which lines the rest of the cavity.

The fibrous coat gives strength to the pharynx, serves to attach it above to the occipital and temporal bones, and by its median raphæ gives attachment to the constrictor muscles.

The muscular coat includes the superior, middle and inferior constrictors, which muscles are concerned in deglutition. When this is about to be performed, the pharynx as a whole is drawn upward and dilates to receive the bolus. As soon as the morsel is received in the pharynx the bag descends, the constrictors contact upon it conveying it downward into the esophagus. The pharynx also acts as part of the respiratory canal and in the modulation of the voice, especially in the production of the higher tones.

The esophagus, or gullet, is a muscular canal about 23 centimeters (9 inches) in length extending from the pharynx to the cardia of the stomach. It commences at the upper edge of the body of the sixth cervical vertebra, descends in front of the spine through the posterior mediastinum, then through an orifice in the diaphragm between the left vertical edge of the bodies of the vertebra and the central tendon, and terminates at the cardia opposite the tenth dorsal vertebra. At its commencement, it is in the median line from which it inclines to the left down to the root of the neck where it again passes to the median line and finally deviates for the second time to the left as it passes forward to go through the diaphragm. Its course also corresponds to the natural flexure of the spine. It is the narrowest part of the alimentary canal, and is smallest at the lower end.

It has three coats—an external muscular; a middle or areolar; and the internal or mucous.

The muscular coat is made up of two layers of muscular fibers, mostly of the striped variety above, and the involuntary below. The fibers of the external layer run longitudinally; the internal, circular

## PHYSICAL AND HISTOLOGICAL ANATOMY.

the mucous layer. Between them are found groups of glands, a nervous formation and small vessels.

The muscular coat loosely connects the muscular layers with the connective tissue. It supports the bodies of a number of small glands and a plexus of nerves which connect with those in the muscular planes.

The mucous coat lines the tube. It is thick, of a reddish color and moist later below. It is disposed in longitudinal folds during the distention of the tube. It contains numerous muscular fibers, the ducts of the glands in the areolar layer and a layer of stratified epithelium.

It is important to note that the epithelium lining the entire upper respiratory canal, from the lips to the cardia, is of the stratified ciliated variety. In the upper respiratory half of the pharynx are scattered ciliated columnar variety with some goblet-cells.

The arteries of the esophagus are branches from the pneumogastric. Its arteries are derived above from the thyroid and the subclavian, in the middle zone from the descending aorta, and terminals from the gastric branch of the celiac axis of the mesentery. For the most part these arteries, with their veins run in a longitudinal direction and anastomose with each other.

## THE STOMACH.

The stomach in man is single; in some of the ruminating animals it is double. It is situated between the lower end of the esophagus and the beginning of the first part of the duodenum, and is the first part of the alimentary canal. As an organ, it is conically shaped, presenting its largest end (fundus) to the left, and the smallest part (pylorus) to the right. It is situated high in the left abdominal cavity occupying with the spleen practically all of the concavity of the left lower ribs below the diaphragm. In the abdomen it lies in the left hypochondriac, epigastric, and occasionally in a small part of the right hypochondriac regions, and in the author's observation, when of normal size and position and when standing, in the umbilical region down to the umbilicus. As a rule, it is more vertical in the female, and thus reaches somewhat lower in the abdomen. It is bounded above by the diaphragm and liver; below, by the small intestine and transverse colon; in front, by the false ribs and anterior abdominal walls; on the left, by the ribs; on the right, the pyloric end reaches to the gall-bladder; and in back, by the spleen, pancreas, left kidney and its suprarenal body. The fundus end is covered by the lower part of the left lung and its pleura, and the left lobe of the liver somewhat covers

the pyloric region in front. From the fact that the fundus and the lesser curvature are quite invested (left lung and left lobe of the liver), palpation of these regions for tumors is rendered impossible, unless the stomach has descended (*gastrophtosis*), or the growth is very large.

The stomach is maintained in its position by a ligamentous attachment at the cardia; at the pylorus by the descending portion

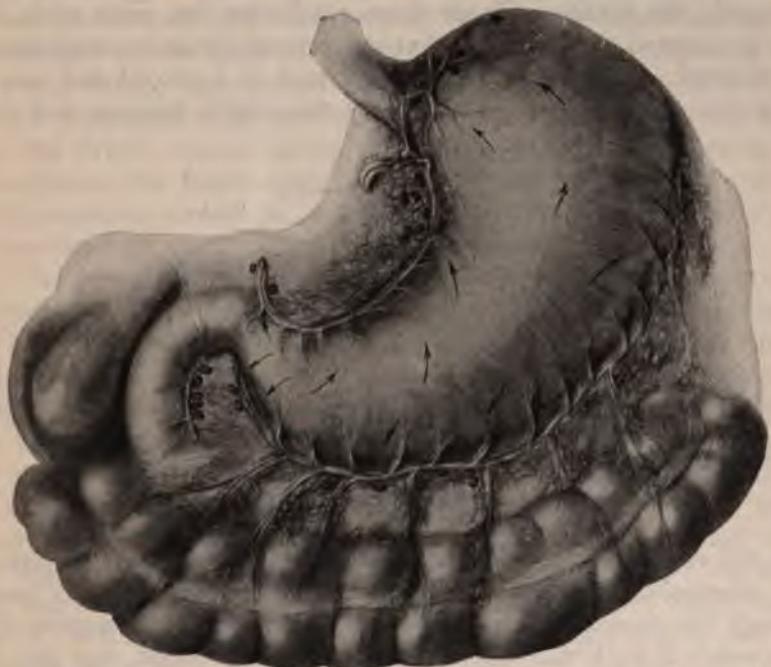


Fig. 1.—Anatomy of the stomach with especial reference to the blood-vessels and lymphatics. The arrows indicate the direction of the lymphatic flow. (After Mayo.)

of the duodenum which is fixed to the spine, and also by the lesser omentum and its suspensory ligaments, which are all parts of the peritoneum. From the diaphragm to the cardia is a special fold known as the gastrophrenic ligament, which is the most fixed point of the stomach proper. The pyloric extremity and the greater curvature are the most movable parts of the organ. The lesser omentum fills in the space between the phrenosplenic ligament on the left. The anterior and posterior surfaces are covered by peritoneum. From the greater curvature of the stomach falls the apron of the greater omentum, which is continued on in the transverse mesocolon.

The arteries of the stomach are the gastric, the pyloric, the right gastro-epiploic and vasa brevia from the splenic. These vessels pass to the stomach in the region of the curvatures and pass through the musculature, mostly at right angles to the submucosa, in which structure they run in larger trunks longitudinal to the organ. From these, vessels are sent into the mucosa, which, immediately after they pass through the muscularis mucosa, spread out in numerous fork-like branches; from these fine branches is formed a capillary mesh which surrounds the tubules. From these capillaries the veins arise, but they are formed mostly from a fine-net venous plexus situated high in the mucosa. These venous capillaries pass to a second and coarser transverse plexus which embraces the muscularis mucosa, and from

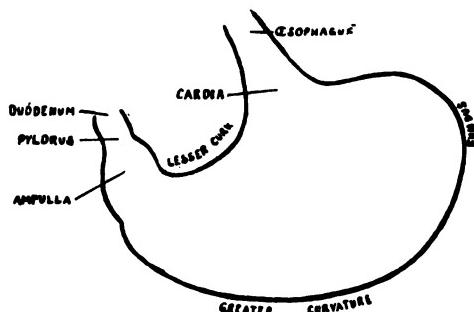


Fig. 2.—Outlines of the normal human stomach.

here the venous blood empties into larger-sized, sacculated trunks in the submucosa, from which in smaller vessels the blood passes through the muscularis and without the organ. The arrangement of the vessels is such that about two-thirds of the blood sent into the organ goes to the mucosa. The arrangement of the lymphatics is much the same as the veins.

The nerves are supplied from the right and left pneumogastric, the former being distributed upon the back and the latter upon the front part of the organ. A great number of branches from the abdominal sympathetic (solar plexus) also supply the walls of the organ.

The stomach varies considerably in size. This depends upon the degree of distention, the height of the individual (often larger in tall persons), sex (smaller in women), and the age (larger in old persons). When filled, the adult stomach in its largest diameter (longitudinal) measures from 25 to 30 centimeters, its widest transverse from 8 to 10 centimeters, and at the pylorus from 2 to 5 centimeters. When empty,

it is about one-third smaller in its longitudinal axis, slightly so in its transverse, and the space at the pylorus is obliterated by the folds of the mucous membrane coming in contact. The capacity of the stomach, according to Ewald,<sup>1</sup> varies between 250 and 1680 cubic centimeters. He considers a capacity of 1600 to 1700 cubic centimeters as the normal limit.

For the purpose of location, the stomach is divided into the cardia, the fundus, the body or intermediate region, the antrum pylori or ampulla, the pylorus, and the lesser and greater curvatures. The antrum pylori is divided from the body by a line of separation marked by a fissure on the small curvature called the *incisura angularis*, and by a less abrupt turn upward in the large curvature (His<sup>2</sup>). This pyloric separation is an important point; for the reason of the angle that the pyloric region makes with the body, the difference in the musculature, the macroscopic and microscopic characteristics of the antrum mucous membrane, and the fact that there is a functional difference between these two parts of the stomach.

The cardia marks the site of the joining of the esophagus with the stomach. It is somewhat funnel-shaped with the large end downward. The esophagus is inserted in the stomach between the fundus and the lesser curvature, at a point about 2 centimeters below the diaphragm. The cardia is situated slightly to the left of the median line at about on a level with the left edge of the ensiform process of the sternum. As it is deep and completely covered by the left lobe of the liver, cardiac growths cannot be palpated (unless under exceptional conditions of prolapse or when having extended along the lesser curvature). The fundus is the largest part of the stomach and extends to the left of the cardia. Its upper limits, about 5 to 8 centimeters, mark the highest point of the organ, and this is about on a level with the costal cartilage of the fifth rib in the maxillary line. It is intimately connected with the diaphragm by means of a reflection of the peritoneum which passes from the abdominal surface of the diaphragm. It lies under the cover of the ribs and is connected posteriorly with the spleen by the gastro-splenic omentum. The pyloric end, the smallest part of the stomach, is situated on a plane anterior and inferior to the fundus in the right sternal line and about 5 centimeters below the tip of the ensiform. At the pyloric orifice it joins the duodenum at which site there is a valve-like formation of muscular fibers (the pylorus). The pylorus is higher and posterior to the ampulla and lies upon trunks of the portal vein and the hepatic artery. Of importance from a practical standpoint are the courses of the two curvatures. The greater

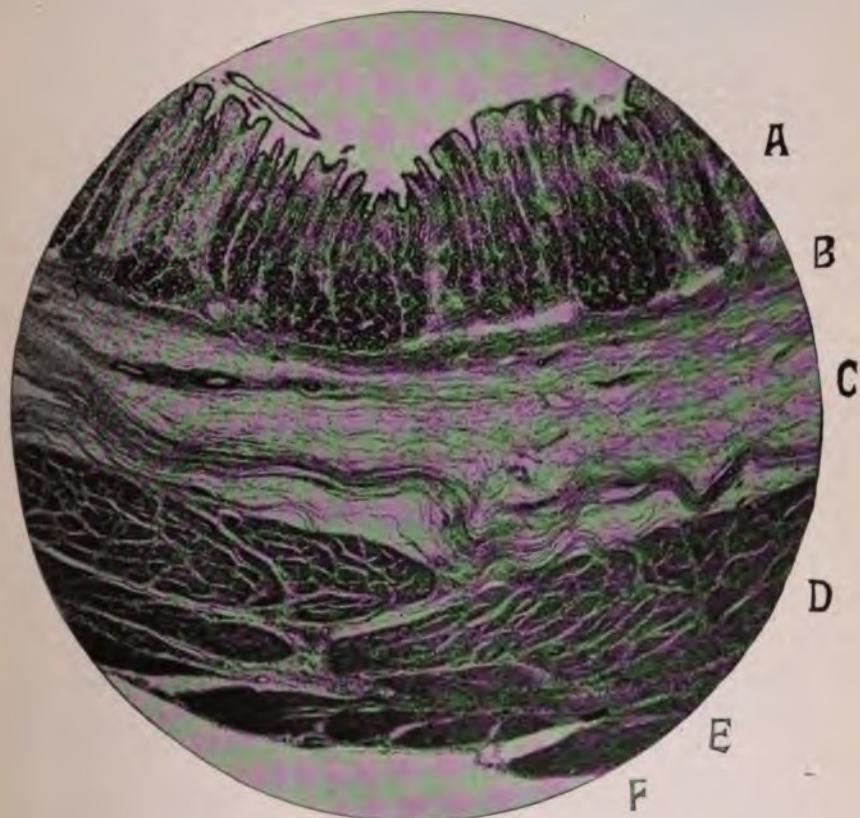
curvature extends downward from the fundus into the left hypochondrium, and descends into the abdomen in a continued convex line from the junction between the ninth and tenth ribs to a point (prone position) in the median line about 1 centimeter above the umbilicus in women, and 2 centimeters in men. From here it rises upward to the right, passes beneath the liver to the front of the median surface of the gall-bladder and terminates at the pylorus. The lesser curvature runs from the cardia to the pylorus, extending in a curved line downward and slightly inward, at about the left line of the bodies of the vertebra. Then, in the neighborhood of the first lumbar vertebra, it makes a sharp turn to the right of the median line and continues a course fairly parallel to the greater curvature to form the upper part of the pylorus. It is connected with the under surface of the left part of the liver and (important to note) is covered by the anterior margin of the left lobe of this organ.

The normal stomach presents a wide range of differences in its size, position and connections. When distended, the greater curvature is elevated and carried forward so that the anterior surface turns upward, the posterior downward and the entire organ presses forward against the abdominal wall. At the same time the fundus pushes the diaphragm upwards, contracting the chest cavity and displacing the heart; hence the symptoms of dyspnea, asthma, palpitation, changes in the pulse, and precordial distress complained of in gastric disorders when large amounts of gas are present. When empty, it lies against the back of the abdomen removed from the front walls. On deep inspiration it descends to or a little below the umbilicus; and on expiration it ascends again. On contractions of the abdominal muscles, such as in straining at stool, vomiting and retching, the pyloric end and part of the body ascends, but the fundic extremity remains quite fixed.

The stomach consists of four layers of component structures—the glandular, the areolar, the muscular, and the serous.

The glandular layer, tunica propria, or erroneously called mucous membrane (because its form of structure and function are to secrete gastric juice rather than mucus), is divided on its free surface into a large number of lattice-like, polygonal, or hexagonal folds by slight ridges. This honey-combed appearance (*état mammelone*) is made to provide for a very rich glandular apparatus. At the bases of the alveoli, which vary from  $\frac{1}{100}$  to  $\frac{1}{300}$  of an inch in diameter, are seen the orifices of the gastric tubules which are situated perpendicularly side by side throughout the entire glandular membrane. The membrane itself is soft and pulpy and of a pinkish-gray color;

PLATE II.



Photomicrograph of a vertical section of a normal human stomach, showing the component structures. *A*, The tunica propria or the glandular layer. *B*, The muscularis mucosa. *C*, The submucosa. The foregoing structures comprise the mucosa. *D*, The circular muscular fibers. *E*, The longitudinal muscular fibers. These comprise the muscularis. *F*, The peritoneum or serous layer.  $\times 30$ .



during gastric digestion, because of the greater quantity of blood in the superficial plexuses around the alveoli, it becomes a much deeper red. It is thickest at the pylorus and thinnest at the fundus. From left to right run larger ridges (*rugæ*) which flatten out when the organ is distended.

The epithelium covering the membrane and down into the ducts of the glands is of the columnar variety. The cardia marks the end of the squamous type found above; and throughout the stomach and



Fig. 3.—Photomicrograph of the epithelium of the normal human stomach, showing the columnar cells which line the organ and the infundibula of the gastric tubules. In the connective tissue on each side of the center are seen portions of the gastric tubules.  $\times 800$ .

intestines the lining cells are cylindrical in form. Aside from these cells recent investigations have shown the presence of a type of cell with a cuticular border line like those commonly found in the intestines. In the locations where these cells are found are also found the cup-shaped goblet or beaker-cells, which at one time were considered as formed by a pathological inclusion of mucus in the cylindrical cells separating the cell-body in the center; Ad. Schmidt,<sup>3</sup> and P. Hari<sup>4</sup> have proven them to be normal cells. Boas<sup>5</sup> divides the cylindrical cell-body into the superficial or mucous portion and the basal or protoplasmic portion; in the latter is situated the nucleus. These cells

secrete gastric mucus and during the process of secretion these two parts of the cell stain differently.

The main bulk of the glandular layer is made up by the gastric glands or follicles. These tubules lie side by side, with usually from four to sixteen openings into the base of a common exit for all. According to Sappey, there are about five million of these follicles in the stomach. These tubules extend from the pits of their alveoli to the muscularis mucosa, a thin layer of unstriped muscle-fiber at their



Fig. 4.—Section through the glandular layer of the pyloric region of the human stomach, showing the openings of a number of glands and the less regular arrangement of the gastric tubules than is found in the body or fundus of the stomach.  $\times 70$ .

bases and the contractions of which serve to express the contents of the follicles during digestion. Just above this muscular layer the glands are divided into numerous branches. At the fundus the glands are less numerous, shorter and more regularly placed, and are called the gastric or glandular follicles. As they approach the pylorus, and at it, they become more convoluted, coiled, more thickly set, are longer and are called the pyloric glands. In this location they form the transition from the simple follicle of the fundus and the body to the convoluted glands of Brunner which lie immediately below the pylorus (Watney). Thus two, and sometimes three, kinds of glands .

are distinguished—the fundic, pyloric and cardiac. The cardiac glands are found around the cardia and are not very definite (Haane<sup>8</sup>).

In their histological structure the glands present differences that doubtless prove that their secretions are different in various parts of the stomach. This is observed mostly in the variety of glands and number of three types of cells that are found in them, the cylindrical, the chief or central, and the acid or parietal.

The cylindrical cells line the pit of the gland and are a continua-



Fig. 5.—Photomicrograph of a transverse section through the gastric tubules of the normal human stomach about two-thirds the distance down from the infundibula of the glands. The rosette of cells in the tubules are the central or peptic cells. At the outer edges of these groups are plainly noted the larger parietal or acid cells. The lower half of the specimen is composed mostly of connective tissue. Stained with hematoxylin and eosin. X about 350.

tion of those on the free surface. In the alveoli, however, they become more cuboidal in shape and are shorter as the summit of the secreting part of the follicle is reached. Here and there, in an irregular formation, a short spear-pointed projection extends from some of the cylindrical cells into the lumen of the duct.

The second type of cell, the chief or central, is a pyramidal or irregularly cuboidal cell with a finely granular protoplasm and a well-defined dark staining nucleus situated near its proximal border. The protoplasm of these cells stains very poorly with the aniline stains

and does not show a well-defined body even in the fresh state. Occasionally in atrophic gastritis these cells can be made out in the wash water (Bassler<sup>7</sup>). Heidenhain has shown that they are almost clear and transparent in the fasting state, and that they become somewhat cloudy and granular during digestion. They are held to be the sources of the pro-enzyme, pepsinogen, and they are the preponderating cell in the stomach.

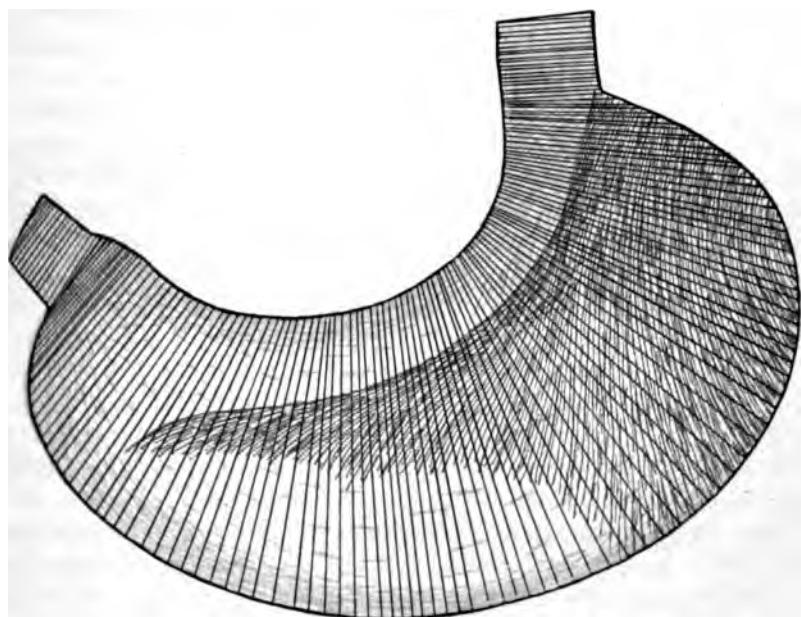
The acid, parietal, or oxyntic cells, are found in fewer numbers than the above, and are usually situated between the central cells and the frame structure of the tubules (border cells). These are usually found rounded, oval-shaped or irregularly triangular with rounded bases. They take up aniline stains readily, display a stippled body (Bassler<sup>8</sup>), and a well-defined spherical nucleus near the center of the protoplasm. They are found in largest numbers about the neck and upper part of the body of the glands, and in the fundic glands they protrude into the lumen of the tubules. Heidenhain believes that they are the sources of the hydrochloric acid content of the gastric juice, although Fränkel<sup>9</sup> and Klug<sup>10</sup> claim in addition that they assist in the elaboration of pepsinogen also. In the author's opinion this has a tenable basis, but only in the way of a direct stimulant to the activity of the other enzyme-producing cells.

During digestion these cells swell quickly (likewise the central, but not to the same relative extent) and return to their original size shortly after the full secretion of gastric juice; while the central cells do not assume their former appearance and size for quite a few hours afterward.

It is well known that the glandular tubules of the pyloric region contain only central cells (producing only fermentants), while the gland tubules of the fundus contain both the acid and central. Heidenhain has shown that the secretion of the fundus (and no doubt to a less extent, in the acid way, those in the body) contain both acid and pepsin, while that from the pylorus was alkaline and contained only the proferments. It has been found by Golge that microscopic canaliculi extend from the acid cells (running between the central) into the lumen of the gland.

The areolar coat consists of loose, filamentous areolar tissue running longitudinally and connecting the glandularis with the internal muscular layer. It serves as a cushion for the glands and supports the blood-vessels previous to their distribution to the tubules (vascular coat). This coat also contains some elastic fibers, and here and there small collections of fat cells. It supports above the muscularis mucosæ which is composed of two or three layers of

PLATE III.



Schematic figure, showing the three layers of fibers that make up the muscularis of the human stomach. Yellow, the longitudinal (external). Black, the circular (middle). Red, the oblique (internal).



smooth muscle bundles which run in various directions giving off-shoots upward to the bottoms of the glands.

The muscular coat consists of three sets of unstriped muscle fibers—the longitudinal, circular, and oblique.

The longitudinal are the most superficial, and are continuous with the longitudinal fibers of the esophagus radiating in a stellate manner from the cardia. They are most distant along the curvatures, presenting a denser formation along the lesser. At the pyloric end they present a thickened band (*ligamenta pylorica*) from which they continue in the longitudinal fibers of the small intestine.

The middle layer is composed of circular fibers which form a uniform covering over the entire extent of the stomach. At the pylorus they thicken, forming the pyloric sphincter, and, projecting into the lumen with a few fibers from the longitudinal, form, with a thickened fold of mucosa, the pyloric valve. The cardia has no distinct sphincter. Thus, the sphincter pylori is firmly contracted during digestion, but gas and fluids can readily escape through the cardiac orifice.

The oblique fibers are limited chiefly to the cardiac end of the stomach where they decussate in various directions in rather a thick layer around the cardia, making possible a tonic closing of this orifice. They are continuous with the circular fibers of the esophagus and are the most internal of the three muscular planes.

The serous or peritoneal coat completely covers the outside of the stomach excepting for a triangular space at the lesser and greater curvatures through which the nutrient vessels and nerves run. Beginning at the under surface of the liver (the transverse fissure) and from that to the left of the diaphragm and esophagus, the two layers of the lesser omentum pass downward to the lesser curvature. From this point they pass separately over the anterior and posterior surfaces of the stomach ending below in a long apron (greater omentum) which covers the front of the intestines and is reflected back to enclose the colon and form the transverse mesocolon which is firmly attached to the vertebral column. The back wall of the stomach is part of the boundary of the lesser peritoneal cavity; the front, part of the greater. This is an important fact to remember in connection with the early diagnosis of collections resulting from perforations of the stomach in the posterior wall.

#### THE INTESTINES.

The small intestine begins at the pylorus and terminates at the head of the large intestine. It is a continuous tube about 5.7 meters

(twenty-two feet) in length which is thrown into many convolutions, occupies the middle and lower parts of the abdomen, and is widest at its beginning from which it gradually tapers down to its end. For the purpose of description it is divided into the duodenum, the jejunum, and the ileum.

The duodenum is the beginning 25 or 30 centimeters (ten or twelve inches) beyond the pylorus and is the widest and most fixed part of the small intestine. It describes a horseshoe course around the head of the pancreas and is divided into an ascending portion, which is freely movable (having part of the lesser omentum) and runs close to the liver and gall-bladder; a descending portion, which is firmly fixed to the vertebra and pancreas (peritoneum only in front) and ending at about the third lumbar vertebra in front of the right kidney and contains the orifice of the common bile and pancreatic ducts (*ductus communis choledochus*); and the last or transverse portion, which swings to the left from the descending at about the level of the third lumbar vertebra, is the longest and narrowest part of the duodenum and is crossed by the superior mesenteric vessels (which exit between it and the under line of the pancreas, which it closely adjoins), and finally it ends in the jejunum.

**The Jejunum.**—At the point where the small intestine receives a complete investment of peritoneum the jejunum begins. Its length corresponds to the upper two-fifths of the small intestine below the duodenum; the ileum, the lower three-fifths. Its convolutions are confined chiefly to the umbilical and left iliac regions. The jejunum is between the duodenum and ileum in size, is very vascular, and its walls are quite thick.

The ileum is very convoluted, and its coils lie in the umbilical, right iliac and sometimes in the pelvic region (*enteroptosis*). Its coats are thinner and not so vascular as those of the jejunum, and it joins with the cecum forming the ileocecal valve.

The large intestine continues the canal from the end of the ileum (cecum), ascends to the under surface of the liver and gall-bladder (ascending colon), turns to the left (hepatic flexure), runs a sagging transverse course across the abdomen a little above the umbilicus (transverse colon), turns downward beneath the lower edge of the spleen (splenic flexure), runs downward (descending colon) and finally terminates in the upper part of the rectum (sigmoid). It is about 1.5 meters (five feet) long and is much wider than the small intestine.

The small and large intestines, like the stomach, have four coats—the serous, muscular, areolar and mucous.

The external, or serous, is the peritoneal investment and serves the purpose of lubricating and keeping moist their external surfaces so as to facilitate their movements. The muscular coat consists of two layers—an outer longitudinal, and an inner circular. The circular fibers are the thicker and more distinct. Their purpose is to advance the contained foods onward by a vermicular and peristaltic movement: the circular fibers stripping the canal, while the longitudinal ones dilate and draw it upward over the passed chyme. There is a ganglionic plexus of nerve-fibers between the muscle layers in the



Fig. 6.—Section through the mucous membrane of an injected specimen of human intestine (jejunum), showing the villi with the central spiral vessels and the vascular mesh or cone. All the dark lines represent blood-vessels filled with the injection mass.  $\times 70$ .

small intestine (Auerbach's plexus), and a secondary plexus inside of the circular fibers (Meissner's plexus). The areolar coat joins the muscular to the lining membrane, contains the vessels before they pass to the glandular and absorbing membrane and a large network of lymphatic vessels, and the Meissner plexus of nerves.

The internal coat of the small intestine has a shaggy or velvety appearance due to the numerous villi which stud its surface. It is of a reddish color, deeper above than in the ileum where it is also the thinnest. It is lined by cylindrical epithelium, and at the alveolar ends of the glands is a fine plane of unstriped muscular fibers (mus-

cularis mucosæ). The membrane supports small effaceable folds (rugæ) and permanent ones which cannot be obliterated on even extreme distention (valvulæ conniventes). These latter, the valvular conniventes, are crescentic projections placed transversely to the axis of the bowel. They serve to increase the absorption surface to which the food is exposed.

The villi, peculiar to the small intestine, are conical-shaped projections of the membrane of from 0.5 millimeter to 0.7 millimeter long. They consist of a prolongation of the membrane, inclosing a network of blood-vessels, one or more lymphatic vessels (lacteals), a few plain muscular fibers and a general building structure of lymphoid tissue. Filaments from the Meissner plexus form arborizations throughout their structure. An arterial twig from the areolar coat mounts a spiral course through them branching into a meshwork of capillaries at their exposed surface.

The lacteal radicle lies in the center of the villus with the small blood-vessels. Sometimes a villus contains two of these absorbing vessels but in the human being rarely more than that. The radicle consists of a delicate layer of flattened epithelium with a few fine filaments of plain muscular fibers running longitudinal to them (Brücke). These fibers cause the interesting movements of the villi which, as Cannon has shown, are directly influenced by the emotions and sensations of distress and pain. In addition to the columnar epithelial cells of the villus, under which there is a large collection of leucocytes during digestion and absorption, are also found numerous goblet- or beaker-cells. These villus epithelial cells are the principal agents in the process of the absorption of food materials from the gut. This is proved by the presence of fatty substances in their structure, although the other products of digestion (peptones, maltose and salts) have as yet not been conclusively proved to be present in them. Hemmeter<sup>11</sup> suggests that the large amount of lymphoid tissue in the lower part of the small intestine seems to be related to absorption in those locations.

Two kinds of true secreting glands are found in the intestines—the glands or crypts of Lieberkühn, and the glands of Brunner. There are also present two varieties of lymph follicles—the solitary, and the collected (Peyer's patches).

The follicles or glands of Lieberkühn are tubular pits lined with columnar epithelium and open between the bases of the villi. They are present throughout all of the intestines (large and small), and extend vertically through the depth of the mucosa. In the duodenum alone are seen an additional type of glands (glands of

Brunner). These resemble those found in the pyloric region of the stomach, excepting that in the intestine they are more divided and sink deeper through the mucosa and often into the areolar tissue. They are of the racemose variety, and open either between the Lieberkühn follicles or into their bases.

The solitary glands are scattered throughout the entire intestine, and are found most abundantly in the ileum. The agminated glands (Peyer's patches) are large, oval lymph follicles, held together by



Fig. 7.—Photomicrograph of a section of one of the agminated glands (Peyer's) from the lower gut of a dog, showing the gland structure, the blind opening, and the follicular glands (Lieberkühn), in the mucosa.  $\times 70$ .

adenoid tissue. They are found best developed in the ileum, where, if they are placed high in the areolar tissue, they cause a pitting of the mucosa.

The blood-vessels of the intestines follow the arrangement of those found in the stomach. They pierce the muscular coats, supply these tissues, then enter the areolar tissue or submucosa and form a wide-meshed network. Surrounding the follicles is a netting of fine capillaries, which, just beneath the epithelium, form a surface network from which the veins arise which collect to form larger-sized vessels in the submucous areolar tissue. The arteries of the small intestine are all the branches of the superior and inferior mesenteric. It can

been computed that during digestion these, with those of the colon, are capable of taking up one-third of the blood in the human body.

The lymph vessels begin in the lacteals where they arise from a blind pouch in the summit of the villi. From here they descend in the septum between the glands to the lymphatic mesh over the muscularis mucosa. Here they join with larger vessels in the submucosa, and from this out are supplied with valves. They continue through the muscular coats and then run between the two peritoneal layers of the mesentery to the receptaculum chyli, which is the lowermost point of the thoracic duct situated opposite the first and second lumbar vertebræ.

The nerves of the intestines are supplied from the mesenteric plexus of the sympathetic which plexus receives branches from the celiac plexus, semilunar ganglion, and also the pneumogastric.

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## CHAPTER II.

### Physiology and Chemistry.

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#### THE SENSE OF TASTE AND RELATIVE SENSE OF SMELL.

THE sense of taste acts as a guide to the individual in the choice of foods, lends to mastication a sense of pleasure, and reflexly stimulates the secretion of the saliva.

The end-organs of taste have a rather wide distribution. The most sensitive regions are the tip, the edges and the back portion of the tongue particularly around the circumvallate papillæ. The sense is also found present in the soft palate, epiglottis, and in the upper part of the larynx. In the latter location, it may be looked upon in the light of a protection to the entrance of foods or fluids into the larynx.

All authorities have agreed that the lingual nerve, a branch of the fifth cranial, supplies taste as well as sensory fibers to the anterior two-thirds of the tongue, and that the glossopharyngeal presides over the posterior one-third and the adjacent structures; but as to where these nerves obtain their special sense fibers is still debatable. It has been conclusively shown that the lingual obtains these fibers from the seventh cranial through its chorda tympani branch, and it is probable that those in the glossopharyngeal come through direct or from the ganglion petrosum high in its course. Some authors believe that the taste fibers of both nerves are supplied by communicating branches from the Gasserian ganglion of the fifth, but Cushing<sup>1</sup> as a result of the complete removal of this ganglion in thirteen instances proves against this contention. He has shown that in no case did the removal of this ganglion destroy the sense of taste in the posterior part of the tongue (glossopharyngeal). Thus we may believe that the taste fibers of this part go directly through the nerve and the petrosal ganglion into the brain with the roots of the nerve to terminate finally in its sensory nucleus in the medulla. He has also shown that the disturbance of the sense of taste in the anterior two-thirds of the tongue (lingual) following the removal of the semilunar ganglion was not a permanent condition. It would

thus seem that the older views of importance (in taste) given to the trigeminus and its ganglion were not entirely true, and that the fibers that course in the lingual from the chorda tympani run through the geniculate ganglion (seventh), and from this enter the brain with the fibers of the portio intermedia of that nerve as well as some fibers from the ganglion of the fifth; because a partial sense of taste may be present in paralysis of the seventh.

It has been shown that the appreciation of bitter substances is most marked at the back of the tongue; sweet and salty substances at the tip; and acids on the border. That the possibility of the appreciation of these tastes is not confined solely to these locations can easily be proved by personal experiment with different tasting solutions.

It is of some importance to remember that the sense of taste can be stimulated by substances dissolved in the blood (sweet taste in diabetes and bitter taste in jaundice), by gases and fluids regurgitated from the stomach (abnormal gastric fermentation, gastric stagnation, hyperchlorhydria, gastroduodenal catarrh). The conditions of the general body or the tongue itself may impair or render absent the taste-sense (ageusia). This may be noted in convalescence from the continuous fevers, in paralysis of the glossopharyngeal and facial nerves, trigeminal disease, basal meningitis, hysteria, tumors, injuries, and the catarrhal changes in the mouth incident to coryza, polypus and atrophic rhinitis. In the debilities and nose affections (sometimes in hysteria) it is usually bilateral and general. Purely subjective perversions (parageusia) are strongly suggestive of hysteria, but may be hallucinations of the insane or an aura of epilepsy. Certain drugs, such as the bromides and iodides, may also give rise to abnormal taste sensations.

That the sense of smell plays an important part in the taste of substances taken into the mouth is a matter of daily observation in the use of condiments and the character and preparation of foods an individual employs. The olfactory sense was spoken of by Kant as "taste at a distance," and there is no doubt that the desire for and zest of certain food-substances are materially enhanced in this way, and that these odorous attributes are of considerable value in a practical way in the feeding of the undernourished. Much of the flavor of fruits, the bouquet of wines, certain vegetables, skilfully savored purées and sauces on meats, and so forth, lose much of their zest when taken with the nostrils held. Time and again in practice, it proves desirable to relieve recovering patients from the ennui and tastelessness of a hospital menu, and sometimes even a change from their own home cooking by placing them under different conditions.

#### MASTICATION, INSALIVATION, DEGLUTITION, AND BUCCAL SECRETION.

Mastication is an entirely voluntary act although it usually takes place in a habitual way without the exercise of the will. The rather loose articulation of the lower jaw with the skull permits of a wide variety of movements, and in the production of these, the masseter,

temporal and internal pterygoids raise the jaw; the digastric, the mylohyoid and the geniohyoid depress it; and the external pterygoids, when acting singly, control the lateral movements. The grinding movements employed in the mastication of foods between the molars are produced by a combination of the various muscles. At the same time the movements of the tongue pass and hold the food between the teeth while the inner wall of the cheeks and lips prevent it from going too far outside of the teeth line. Finally, the tongue is the all-important organ in gathering the food into shape and position for the act of swallowing.

During the act of macerating and comminuting, the food comes in contact with the first digestive secretion—the mixed saliva, from the salivary glands, which have a direct connection with the taste fibers, and the numerous mucous glands about the mouth. This secretion, in addition to its digestive action on the starches, serves also in the important functions of moistening the foods and adding mucin so as to render it suitable for swallowing. By dissolving dry and solid foods it provides a most important duty in stimulating the taste sensations, which, as Pawlow has shown even in the dog that bolts his food, is an essential step to the secretion of the gastric juice.

While the exact method of action by which the secretion is brought about is still on debatable ground among physiologists, there is little doubt that it is reflexly and quickly stimulated in the hungry by the taste and even by the mere sight or thought of food. That the presiding center for this in the human being, which no doubt is located in the medulla, can also be unfavorably affected by inverse influences, such as fear, embarrassment and anxiety, was plainly shown in one of my patients, who, as a result of a severe mental shock, suffered from a continually dry mouth and throat, had practically no salivary secretion during the mastication of her meals, and was compelled to take fluids for three days, after which time when the mental strain was abated the secretion quickly re-established itself.

Pure saliva is a colorless, opalescent fluid of a weakly alkaline reaction (indicator methyl-orange), with a specific gravity of about 1.003. It has been computed that about 1500 grammes are secreted per diem. The most important constituents are a diastatic enzyme known as ptyalin, mucin, maltose, traces of protein, sulphocyanide of potassium, carbon dioxide, and a variety of inorganic salts of which the carbonates are particularly abundant (the morphological elements of the saliva are described further on).

The important constituent of the saliva is the enzyme ptyalin, or

salivary diastase. Its action is energetic upon the starches which it converts into sugar and dextrin by a hydrolytic process in which the starch takes up water and undergoes a cleavage into simpler molecules. Thus is evident the practical value of cooking vegetable foods in the way of preparatory hydrolysis. The power of the ptyalin can easily be demonstrated on one's self by holding a little boiled starch or boiled potato in the mouth for a few moments and then testing same with Fehling's solution, when it will be seen that the solution is more or less reduced by the presence of sugar.

It is true that the amount of starch conversion in the mouth from the saliva is small, and also that its diastatic action is quickly stopped by the free acid of the stomach (Chittenden has shown that 0.003 per cent. of hydrochloric acid is sufficient to arrest the action of the enzymes and there normally is more than that proportion in the gastric juice), and that there is no absorption of any of the end-products of starch before the stomach is reached. Recently, proved facts concerning digestion in the stomach have shown this preparatory action to be important. Cannon and Grützner have shown that foods remain undisturbed in the fundic end of the stomach for a long time, and thus escape mixture with the acid of the gastric juice; consequently this is of importance in completing salivary digestion of the starchy foods, and their inversion, more or less complete, before the small intestine is reached, where this conversion is carried to its completed extent and the resulting product (maltose) is absorbed.

Here then is a matter which, in the consideration of the therapy of gastric disorders, up to this time has not received the extent of practical application it deserved. In many of the cases of abnormal gastric fermentation, and so-called "amylaceous dyspepsia," conditions usually due to faulty conversion of the carbohydrates, the knowledge of these facts and their correction (which is easily brought about by the more thorough chewing of foods and the limiting of fluids taken with meals) can be of signal service in the treatment of these conditions. The author believes that the sometimes good results that have been obtained from the habit of chewing gum after meals is due to the extra saliva that is secreted and swallowed to mix with the food that is contained in the fundus in the early period after the completion of the meal, and not to any pepsin or other substances that certain makes of chewing gum may contain. In the rush and hurry of busy life, to which there came as time savers places where foods are always ready for immediate delivery, time enough may not be taken for the proper mastication and salivation of

foods before they are swallowed. There are no teeth in the stomach, and when food has once reached there it is beyond mechanical comminution in the normal way, and, unless it has been salivated and comminuted sufficiently, digestion suffers, particularly in those who habitually partake of vegetable foods of the rough kind and meats.

If saliva be permitted to stand, two distinct layers will form, viz., an upper clear and a lower cloudy layer; the latter contains certain morphological elements. Among these are the salivary corpuscles, basement epithelial cells, and micro-organisms.

The salivary corpuscles are probably derived from leucocytes which have escaped from the glands and then undergone a change to a larger size and coarser appearance. In the many I have observed I have never been able to discern a definitely apparent nucleus in them. Up to this time no significance has been attached to these bodies.

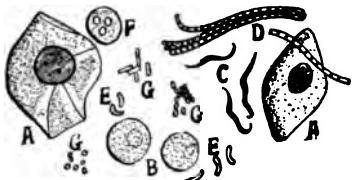


Fig. 8.—Buccal secretion from a healthy subject. *A*, Epithelial cells. *B*, Salivary corpuscles. *C*, Spirochæte buccalis. *D*, Leptothrix buccalis. *E's*, Comma bacilli of the oval cavity. *F*, Leucocyte. *G's*, Various forms of fungi. X about 1500 diameters.

The epithelial cells are large irregular polygonal ones provided with a most distinct nuclei and nucleoli. They belong to the class of stratified epithelium and often contain a large amount of fat.

Micro-organisms in large numbers are found in the mouth, and sometimes also molds and schizomycetes. Among the commonly found denizens are the *Leptothrix buccalis innominata*, the *Bacillus buccalis maximus*, the *Leptothrix buccalis maxima*, *Iodococcus vaginalis*, *Spirillum sputigenum*, and the *Spirochæta dentium*. Other organisms of a non-pathogenic nature are also found—the *Bacillus smegma* and the *Leuconostoc hominis*, together with many more that little is known about because they cannot be cultivated by laboratory methods.

Pathological micro-organisms are also found in healthy individuals. The *Diplococcus pneumoniae* is commonly present even in its virulent form. Streptococci are frequently observed; they most often are non-virulent. The pyogenic staphylococci are less common than the streptococci. Parks and Beebe found the diphtheria bacillus in

healthy throats of 8 out of 330 persons who had not been exposed to cases of diphtheria. The *Micrococcus tetragenus*, *Bacillus pneumoniae* of Friedländer, *Bacillus crassus sputigenes* and the *Bacillus coli communis* have also been observed in normal mouths.

Deglutition is a complicated reflex act which is independent of the will although it may be initiated voluntarily. Its first part is brought about by the elevation of the body and tip of the tongue against the soft palate when the bolus of food is being pressed backward through the fauces. The second part comprises the transit through the pharynx into the esophagus. This rather complicated movement is quickly performed by the contraction of the mylohyoid muscle in the floor of the mouth (Kronecker and Meltzer<sup>2</sup>), assisted by the contraction of the hyoglossi, and probably by the constrictors of the pharynx. At the same time a number of other muscles are brought into action to shut off the nasal and laryngeal openings, and thus prevent the entrance of food into the corresponding cavities. The whole reflex is a finely co-ordinated movement. According to most observers, it is not necessary for the protection of the larynx that the epiglottis be pressed down, for in swallowing, the forcible uplift and anterior movement of the larynx and the descent of the base of the tongue over same sufficiently prevents the entrance of food. The approximation of the true and false vocal cords assists in the preventing of foods entering the larynx. The last part of the act of deglutition is the passage through the esophagus, which is involuntary. It begins after elevation of the larynx which serves also to open and enlarge the entrance of the esophagus, and since the laryngopharyngeal junction is normally closed this is an important point to remember in the passing and guidance of the tip of a stomach-tube. When the food is soft or fluid it is sent through the esophagus without the necessity of peristalsis to assist it downward. Such substances arrive at the cardia in about one-tenth of a second, and may be held there (in the esophagus) for some seconds until the sphincter or tone of the cardia relaxes. When, however, the food is solid or of stiff consistency, as Cannon and Moser have shown, it is forced through the esophagus by the peristaltic movements of the musculature. The circular muscles are constricted from above downward in an advancing muscular wave, while the longitudinal muscle fibers contract in advance of this wave so as to dilate the tube and facilitate the passing of the bolus onward. In two X-ray observations that the author made with small bags containing bismuth subnitrate, it was observed that this passage downward was continuous and took about six seconds for the bags to reach the lower esophagus. It will, therefore, be seen that

the difference in time in the passage of fluids and solid foods, such as meat, etc., is as one to six. The advancing wave of peristalsis either forces the food through the feeble resistance offered at the cardia, or the sphincter suffers an inhibition at this moment as part of a reflex from the presence of food at that point. Kronecker and Meltzer have noted that, if a second swallow was made before the bolus previously taken had reached the cardia, the passage of the lower bolus was immediately arrested at whatever portion of its path it may have reached, that it waited there until it was joined by the second, when both went down together.

Accompanying the passage of fluids through the pharynx a sound is produced which in many persons is audible at some distance. Its volume seems to depend upon the quantity and the rapidity of the passage of the fluids. More frequently, and of considerable diagnostic importance, is a sound that is produced by the passage of liquids through the cardia. This according to Kraus is produced by the penetration of air into the stomach, which since has been confirmed by Kantor. Both sounds can often be heard (sometimes not the first) by placing the ear or the bell of a stethoscope at the ensiform. Often only one sound, the first or the second, is heard. This is generally due in the case of swallowing fluids to the two sounds being produced so close together (one-tenth of a second apart), and the fact that one or the other may be quite inaudible at this point. I have occasionally heard the cardia sound best in the back a little to the left of the spine in the lower dorsal region, and have heard it there when it was not audible in front. It has been my observation that it is loudest when there is more or less gas in the stomach, and also when the fluid is swallowed quickly and forcibly. In some measure the presence of these sounds is of value in diagnosing the permeability of the cardia; and in their absence or delay that fluids, for some obstructing reasons at the cardia or in the gullet, did not pass through the cardiac orifice normally. Occasionally, with the employment of more solid foods, the cardia sound is of value in discerning deficiency in the peristaltic power of the esophagus. As fluid passes the cardia into the stomach a squirting sound is heard, which usually occurs from six to seven seconds after the fluid had entered the upper gullet.

### GASTRIC JUICE, PHENOMENA OF SECRETION, GASTRIC MOTILITY.

#### THE GASTRIC JUICE.

The gastric juice in its pure state is a clear, faintly yellow fluid, acid in reaction and possessing a specific gravity of about 1.002.

It has a stale, sour taste, and is almost odorless. As it is not secreted in its normal state excepting during the process of digestion in the stomach—when it quickly becomes mixed with the foods—pure specimens of gastric juice for analysis cannot be obtained. The nearest approach to this was obtained by Pawlow in his classical experiments upon dogs with esophageal fistulæ and to which a fictitious meal had been given which did not reach the stomach, but which nevertheless reflexly stimulated the flow of the gastric juice.

It has been computed that the daily secretion of gastric juice is about one-tenth of the weight of the body; about 1500 c.c. in twenty-four hours. The largest constituent is water, and it is remarkable to note the small quantities of solid matter present. In this connection Schmidt's analysis of the composition of the gastric juice is: water 994.40, and solid residue 5.60 per 1000, of which the chlorides and phosphates make almost the entire quantity of salts. The reaction of the gastric juice is due to the presence of free hydrochloric acid in quantities of about 0.4 per cent. in the normal stomach, and the digestive power of the juice is due to the uniting of this free hydrochloric with the pro-enzyme, pepsinogen, chemically forming the completed enzyme, pepsin. This is probably also true, but difficult to prove, of the second or fat-splitting enzyme, called lipase. The author does not recognize rennin as a separate ferment, and believes that milk-curdling is only a phase of the albuminoid digestion of milk, by pepsin, and not a separate process.

Carlson, in his studies of gastric juice, from a case of gastric fistula, reported the following:—

1. **Solids of the Gastric Juice.**—The appetite juice contains solids varying from 0.48 to 0.58 gram per 100 cubic centimeters, of which 0.34 to 0.47 is organic, and 0.11 to 0.14 is inorganic material. The hunger gastric juice is distinctly higher than the appetite juice in total and in organic solids.

2. The specific gravity varies between 1.006 and 1.009 with an average of 1.007. The specific gravity of the hunger juice is higher than that of the appetite juice series since the solids are higher.

3. Osmotic concentration of the gastric juice varies; for instance, the hunger juice has, on the whole, a lower osmotic concentration than the appetite juice.

4. (I) Nitrogen averages 0.06 gram per 100 cubic centimeters of appetite juice; the hunger juice was not examined. It is probable that some of the nitrogen is present in non-protein combinations, such as ammonia, amino acid and sulphocyanic acid.

(II) Ammonia varies from 2 to 3 milligrams per 100 cubic centimeters of juice, and appears to be slightly more concentrated in the con-

tinuous secretion or hunger juice than in the appetite juice. Carlson limits the origin of the gastric juice ammonia to the following factors:—

(a) Active excretion from the blood, in which case one would expect an increase in the ammonia in increasing blood ammonia. In normal individuals there seems to be a decrease in the elimination of ammonia by the kidneys during gastric secretion.

(b) The ammonia may be found in the secretion process itself.

(c) Action of HCl on cells of the mucosa (splitting off of ammonia by the cells as a protective measure against the action of strong acids).

(d) Action of HCl on the protein of the gastric juice (conversion of alkaline and neutral proteins to acid proteins).

(III) Amino acids. Normal human gastric juice contains slightly more amino acid than ammonia nitrogen, but the greater part of the juice nitrogen is associated with the more complex proteins.

(IV) Autodigestion. When fresh gastric juice is incubated at 38° C. the following changes take place in the proteins and in the gastric mucin:

(a) Theropy mucin and mucin floccules are dissolved.

(b) Pink color of biuret reaction is intensified.

(c) The characteristic protein precipitation at the point of neutralization is decreased.

(d) Quantity of protein precipitated by nitric acid and by heat is reduced. It is probable that this autodigestion of the gastric juice is a factor in the continuous secretion of the gastric juice.

(V) Normal human gastric juice contains a sensitizing substance for human serum, but it is practically devoid of toxic substances, both in relation to the protein of the gastric juice and to serum proteins.

5. Acidity of normal gastric juice. Of much interest is the statement that "normal human gastric juice is equal in total acidity to the maximum acidity reported by clinical observers for so-called hyperacidity in man, and there is no evidence that the gastric glands under any pathological conditions are able to or do secrete of higher than normal acidity. Moreover, the presence of gastric juice in the stomach of full acid strength leads by itself and immediately to no untoward symptom."

6. Chlorides are very constant, the minimum being 0.49 per cent. and the maximum, 0.56 per cent. chlorine.

7. Pepsin was found to be present in excess of the needs or at least far in excess of that needed in economic digestions.

#### PHENOMENA OF SECRETION.

Pawlow's<sup>3</sup> work on the phenomena of secretion has cleared up much of the doubt and errors of the older observers, and has estab-

amount of weight, the greatest quantity of gastric juice is required by meat and the smallest by milk. In all diets, a pause of from four and a half to ten minutes exists between the introduction of the foods and the beginning of direct secretion; this is called the "latent period." Hence it is, that gastric secretion begins by a reflex to the stomach from the stimulation of the special senses—taste, smell, and sight of food. This is followed by a short interval or pause, after which the stimulation of the secretory and trophic fibers of the gastric glands, "appetite juice," continues the secretion until the departure of the contents from the stomach, and also for a short time longer during digestion in the small intestine. In the latter portion of the digestive tract the innervation of the pancreas and its secretion is reflexedly stimulated by the acidity of the chyme from the stomach, and the degree of this stimulation is proportionate to the degree of acidity of the chyme, a neutralization of the latter causing inhibition of pancreatic secretion.

#### GASTRIC MOTILITY.

The motor activity of the stomach serves to mix the foods, to encourage their saturation with the gastric juice, and to press the chyme onward into the small intestine. The first is accomplished by the motor activity of the stomach assisted by the passive movements transmitted to the stomach by the diaphragm and abdominal muscles during respiration, by the compression of the liver and spleen, and the impulse transmitted to the stomach by the heart.

After a meal, the solid food remains in the stomach for some hours. During this time, the stomach contracts upon it in such a way that the thinner portions of chyme are ejected intermittently from time to time through the pylorus into the intestine. Except at certain times when the pylorus opens, the food is shut up within the organ by the spastic contraction of the pylorus and the tonic contraction of the cardia.

The first movements of the stomach during digestion are the rhythmic contractions of a peristaltic nature that begin slightly in the fundus and pass with increasing force to the pyloric region; in this the circular fibers are the most active. In the pyloric region, and less so in the body of the organ, as digestion continues these waves may be noted by X-rays to occur regularly and to be most active, and the point at the lesser curvature where they seem to begin most actively is called the incisura angularis. They also serve to lengthen the pyloric region into which the food is pressed from the intermediate portion. The obvious result of these movements is to mix the food

PLATE IV.



Roentgenograph of a normal stomach in an adult male, showing the physiological phenomena of the *incisura angularis* in lesser curvature, with the corresponding depression below it in the greater curvature; the rounded end due to the shortening of the pyloric region incident to food propulsion into the duodenum; the closed pylorus after this had taken place (pyloric reflex); the course of the contents along the horseshoe of the duodenum, and the point at which the content stops for the instant, sacculates, and regurgitates up the horseshoe for a distance of about 5 centimeters before it takes its onward course along the lesser part of the duodenum. Marker at the umbilicus. (Made in the author's X-ray department.)

amount of weight, the greatest quantity of gastric juice is required by meat and the smallest by milk. In all diets, a pause of from four and a half to ten minutes exists between the introduction of the foods and the beginning of direct secretion; this is called the "latent period." Hence it is, that gastric secretion begins by a reflex to the stomach from the stimulation of the special senses—taste, smell, and sight of food. This is followed by a short interval or pause, after which the stimulation of the secretory and trophic fibers of the gastric glands, "appetite juice," continues the secretion until the departure of the contents from the stomach, and also for a short time longer during digestion in the small intestine. In the latter portion of the digestive tract the innervation of the pancreas and its secretion is reflexedly stimulated by the acidity of the chyme from the stomach, and the degree of this stimulation is proportionate to the degree of acidity of the chyme, a neutralization of the latter causing inhibition of pancreatic secretion.

#### GASTRIC MOTILITY.

The motor activity of the stomach serves to mix the foods, to encourage their saturation with the gastric juice, and to press the chyme onward into the small intestine. The first is accomplished by the motor activity of the stomach assisted by the passive movements transmitted to the stomach by the diaphragm and abdominal muscles during respiration, by the compression of the liver and spleen, and the impulse transmitted to the stomach by the heart.

After a meal, the solid food remains in the stomach for some hours. During this time, the stomach contracts upon it in such a way that the thinner portions of chyme are ejected intermittently from time to time through the pylorus into the intestine. Except at certain times when the pylorus opens, the food is shut up within the organ by the spastic contraction of the pylorus and the tonic contraction of the cardia.

The first movements of the stomach during digestion are the rhythmic contractions of a peristaltic nature that begin slightly in the fundus and pass with increasing force to the pyloric region; in this the circular fibers are the most active. In the pyloric region, and less so in the body of the organ, as digestion continues these waves may be noted by X-rays to occur regularly and to be most active, and the point at the lesser curvature where they seem to begin most actively is called the incisura angularis. They also serve to lengthen the pyloric region into which the food is pressed from the intermediate portion. The obvious result of these movements is to mix the food

PLATE IV.



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thoroughly in the smaller part of the stomach, where the most active part of gastric digestion takes place. This mixing with the acid gastric juice reduces the food to a thin liquid mass—the chyme. The pylorus then opens, assisted by the shortening of the whole pyloric region and a rounding of the pylorus itself, and this fluid mass is delivered into the duodenum in small jets. According to Cannon, this irregular act of the pylorus occurs in the human being about every twenty seconds and is partly dependent upon the acidity of the chyme and the consistency of the food directly inside of the pyloric valve at that time.

Alverez has pointed out that the digestive tract is largely autonomous and that the forces underlying peristalsis lie largely within the stomach or gut tissue itself. The consensus of belief among physiologists is that the rhythmical contractions are myogenic in origin, coming from the Auerbach plexuses which have no reflex arcs. A peristaltic wave seemingly can proceed both ways from a stimulated point. In the intestinal canal a bolus moves aborally because the pressure is greater on the upper than on the lower side, and this difference in pressure is probably due to the graded characteristics of its muscle. These gradient differences are probably due to the local structure of the neuromuscular mechanism. It probably is local disease in the stomach and gut walls more than any other reason that accounts for deficiency of peristalsis, its irregularity, and loss of tone in that section of the digestive canal.

Several X-ray observations and stomach-tube examinations that I made in cases of atrophic gastritis where there was present a complete anacidity in so far as hydrochloric acid was concerned and only a very low proteolytic digestive capacity, showed that the absence of the hydrochloric acid in the chyme made but little practical difference in the regular action of the pyloric muscle. It was noted that this reflex was performed in almost the regular way, occasionally somewhat delayed, and that the stomach was emptied in about the proper length of time. For these observations the patients had been given to eat boiled vegetables and meat foods of as firm consistency as possible. Certainly, in these cases, no mineral acids of determinable quantities were present with the food in the stomach, and in several of them tests of extracted small quantities of the meals showed no increase of acidity (organic acids) above that of the foods before they had been ingested. It is my belief, based on these observations, that the consistency of the chyme at the pylorus, and probably its newly formed chemical constituents, has to do with the relaxation of the pylorus in addition to the degree of acidity itself. This belief is fortified in being true by the fact that fluid food, when taken alone, may be forced

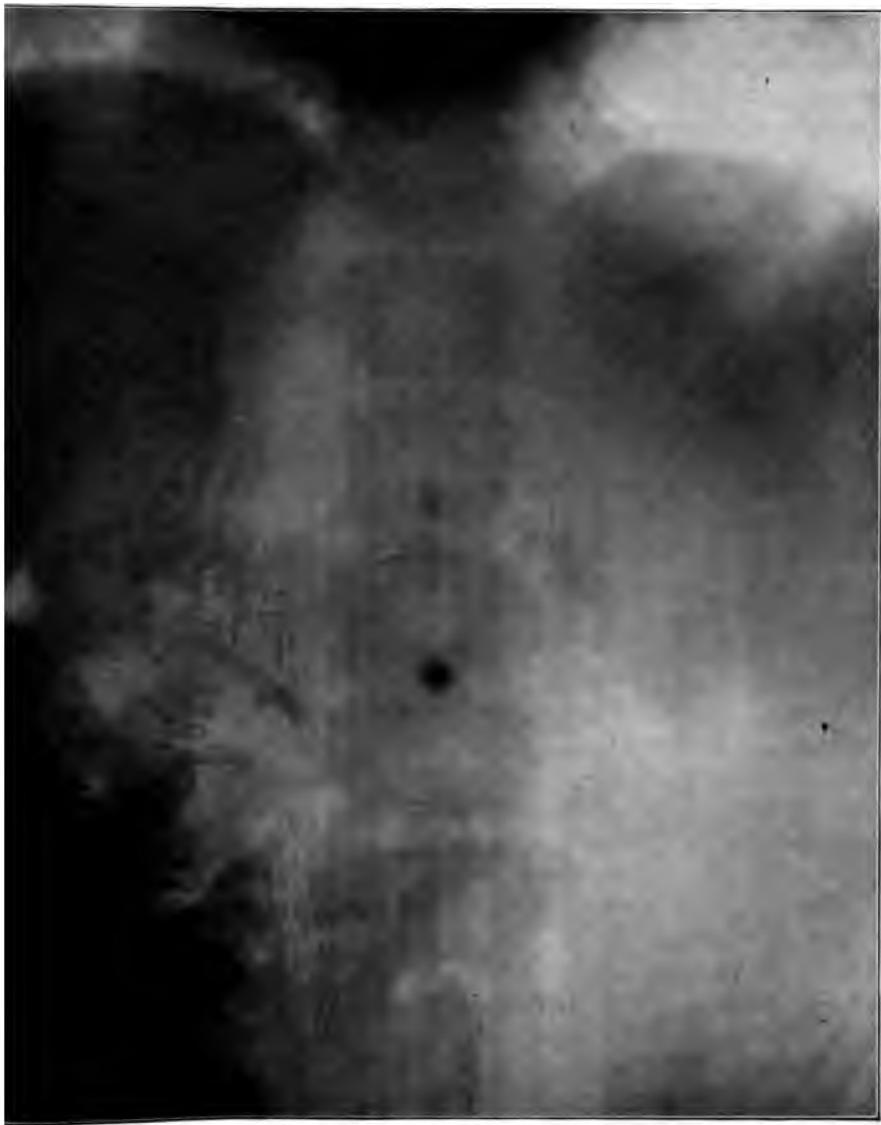
into the duodenum within a few minutes after ingestion. Furthermore, I observed that during these digestions the movements were not increased over that of the normal stomach (hypermotility), and that no abnormal change in the pyloric muscle (pyloric relaxation) existed. Also, that although there was no acid present in the chyme as it was passing into the duodenum, in these cases, the pylorus closed properly, thereby preventing for the time being further exit of food. This may have been due to the reflex alone, to the action of secretagogues, or possibly to the mere presence of food in the first part of the duodenum.

According to Cannon, hydrochloric acid in the stomach seems to favor or produce a relaxation of the pyloric sphincter, and when this acid gastric chyme is in the duodenum it causes a contraction of the sphincter. In this way, it is assumed that the pylorus is opened for the exit of the food, and closed again when it is in the small intestine where its acidity becomes neutralized by the alkaline secretion of this part of the alimentary canal, and after which, the pylorus again opens for the exit of more food to the small intestine, and so on, until the stomach is emptied.

Starling<sup>5a</sup> summarized the subject by saying that we probably have in the walls of the alimentary canal a local nervous mechanism for the movements of the pyloric sphincter. This may be played on by impulses starting either in the stomach or in the duodenum, probably by the contact of acid with the mucous membrane. Increasing acidity on the side of the stomach causes relaxation of the orifice, whereas acidity on the duodenal side causes contraction of the pyloric orifice. The exact parts, however, played in the mechanism by the local system and by the central nervous system, respectively, have not yet been thoroughly made out, though there is no doubt that these movements may proceed independently of any connection with the central nervous system.

It has lately been pointed out that these deductions, drawn largely from observations on laboratory animals, are not entirely in accord with clinical observations. It is asserted that in cases of so-called hyperacidity, a retarded emptying of the stomach with resulting atony and dilatation is often found, and also, that in cases of achylia gastrica, in which there is practically no free acid found in the stomach, the normal rate of discharge is often unimpaired. It seems probable, therefore, that the presence of an acid reaction is not the only essential factor in the control of gastric discharge. It would be futile to recite the details of the conflicting reports. Further carefully planned investigations in this field are clearly needed to unravel the tangle of discrepancies. In recent studies by Morse, of the laboratory of physiology of the Northwestern University Medical

PLATE V.



Roentgenograph of a normal stomach, showing the "water street." In this instance the bismuth was drunk when a considerable amount of food was in the stomach, and a separation between this food and the lesser curvature took place along which the bismuth ran into the duodenum. The channel made through the stomach is shown by the vertical lines and curved end, terminating in the pyloric region in the vicinity of the beginning of the pyloric ampulla. Some of the outgoing bismuth is seen in the ascending portion of the duodenum, the rest being in the lower portion and the duodenojejunal angle of the small intestine at the back of the body of the stomach. The major portion of the bismuth is in the coils of the jejunum and ileum, a portion of which is seen ascending in front of the body of the last lumbar vertebra. (Made in the author's X-ray department.)



School, the abolition of sympathetic reflexes which might inhibit the effects sought to be determined was accomplished by making observations on animals in which the spinal cord was in part destroyed. Quite unexpectedly throughout these experiments the presence of acid in the stomach in general has been observed to retard rather than hasten gastric discharge. It is reported that water is discharged from the fasting stomach of anesthetized pithed dogs more rapidly than any percentage of acid. The rate of discharge is decreased with increase of acidity. Duodenal regurgitation, as evidenced by increase in the contents of the stomach, often occurred at 0.2 per cent. acidity, and in nearly all trials occurred at or before 0.3 per cent. acidity was reached. Increase in acidity increased the frequency and amount of regurgitation from the duodenum.

Wheelon and Thomas, of the St. Louis University School of Medicine, have succeeded in recording simultaneously the motor activities of the antrum and the pyloric sphincter, and in demonstrating that they are remarkably co-ordinated and in a high degree dependent on each other. It may be regarded as established that the antrum is an organ of special motility, the purpose of which is to mix the ingesta and bring them into contact with the gastric juices, and to propel the semidigested chyme onward into the duodenum. The direct graphic and roentgenographic observations of the St. Louis physiologists indicate that the phases of activity in the sphincter are such as to supplement those of the antrum; hence the motility of these two parts may be considered as constituting a cycle of the pars pylorica. The outcome is that the sphincter is open during the greater part of the antral contraction and actively closed while the antrum is relaxing. In other words, the behavior of the pyloric sphincter is the physiologic consequence of the state of contraction or relaxation of the part of the stomach adjacent to it. The familiar "law of the intestine"—the seemingly purposeful interrelation of contraction and inhibition, respectively, in connected segments of the enteric tract—is apparently followed. As for the possible rôle of acid, as Wheelon and Thomas state, one cannot but conclude that if it really acts to regulate the pylorus it must also act in a similar way on the antrum and stomach as a whole; for "the motility of the antrum determines the motility of the sphincter."

The older views on gastric motility were, that the contents of the stomach went through the course of rotary movement in the direction of down the greater curvature and back again along the lesser until the contents were uniformly mixed. Grützner<sup>6</sup> (also Cannon) have shown contrary to this that the slight waves in the fundic end do not materially affect the contents in that part for a long time, and that the food there, to a great extent, escapes admixture

with the acid gastric juice. This is a most important fact in connection with the salivary digestion of starchy foods. Under these conditions the salivary digestion (ptyalin) may go on for an hour or more before it is inhibited by coming in contact with the acid of the gastric juice. Grützner has shown in rats (and most probably the same fact also exists in man) that swallowed food arranges itself in consecutive layers in the stomach, one layer inside of the previous one. In all probability, because the stomach when empty has a certain definite size even when its walls may be in more or less contact at the pyloric region and body (the fundic end is never in contact as it usually contains some gas), the first morsels of a meal take a general course anywhere in the organ until a certain quantity of food is contained in the viscus, although X-ray observations with a fluid bismuth mixture show that the fluids drop directly downward from the cardia to a vertical point at the greater curvature, and then flatten out there before they coat the inside of the organ. Then, as more food is added, the stomach is distended and exerts an equal and tonic pressure within, and the food after that arranges itself in layers in the interior of the cavity, the fundic end merely pressing upon the food, while the pyloric end moves it actively about at that zone. It is obvious that the taking of fluids with the meals might, by acting as a diluent to the gastric juice, cause the hydrochloric acid to more quickly permeate the more quiet fundic portion and thus stop or interfere with the conversion of the starches by the ptyalin. While definite baneful effects of this midmeal-drinking is difficult to prove, there is much suggestion contained in the gastric distress of many of those who partake largely and habitually of soups before the solid portions of the meal, or the dyspeptic American who washes down his food with ice-water. In these, most of whom are cases of sensory neuroses, the simple taking of a drier diet free from fluids is all that is usually necessary to correct the condition. And along these same lines comes much of the benefit of eliminating the fluids in cases of simple gastric atony and atonic ectasia not due to pyloric stenosis. In these latter conditions, the muscular tone of the stomach is impaired, and the ingested fluids mix more readily with the solid portions of the food even in the fundic end. From recent physiological observations it would seem as though nature provided against the danger of the diluting of the gastric contents during digestion by the drinking of fluids during the course of a meal, by the rapid elimination of this fluid from the stomach into the intestine. O. Cohnheim has laid much stress on the observation that even in a stomach containing much food, the ingestion of a large quantity of fluid causes a separa-

tion of the food from the lesser curvature, along which the fluid runs quickly into the duodenum ("water street"). It would thus seem probable that under such conditions more or less inhibition of gastric digestion takes place at those moments, and that the acid-enzymotic secretion in the locality through which the fluid is washing is more or less carried out of the organ with it.

It has been found that the carbohydrate foods begin to pass out of the stomach soon after ingestion, and require but about one-half of the time necessary for the proteins (meat, fish, etc.). Fats remain long in the stomach when taken alone, and when combined with other foodstuffs they markedly delay their exit through the pylorus. Cannon has shown that this regulation is controlled by the stomach itself and is independent of the extrinsic nerves. If in a given diet of carbohydrate and protein the carbohydrate is taken first, it, having the pyloric position in the stomach, will quickly pass out through the pylorus while the protein remains for more thorough gastric digestion. But if this is reversed and the protein is fed first, the passage of the carbohydrate will be materially delayed. If the carbohydrate is thinned by adding water, there is, within limits, very little change in the rate of exit from the stomach; but adding water to protein foods tends to make the discharge more rapid. When hard particles are present in the food, the rate of exit from the stomach is notably retarded, but coarse, branny foods leave the organ slightly quicker than similar foods of a finer texture. The presence of gas in the stomach retards gastric discharge, an effect due to the gas preventing the walls of the stomach from exerting the normal mixing and propelling action on the food. There seems to be no difference in the rate of exit between foods that are fed very hot and very cold. Food with a normal acidity leaves the stomach much faster than when it is hyperacid, and the feeding of acid foods seems to markedly increase the motility of the organ.

Regarding the general mechanism of the stomach it may be stated that it forms an admirably adapted organ for receiving in a short space of time a large amount of food, which it reduces to a fluid or semifluid state. This reduction is brought about in a chemical and mechanical way, and when completed, small quantities are sent into the intestine under such conditions as insure the most rapid digestion and absorption.

It has recently been suggested by Luckhardt and Hamburger that contractions may occur in the empty stomach. The individuals studied were abnormal subjects, yet it is reasonable to believe that these occur in

all persons and are simply those of "hunger contractions" which are a distinct phenomena of hunger or long absence from food in the organ.

The stomach, like the intestines, is essentially an automatic organ. The vagi and splanchnics merely regulate the peristaltic and shortening actions. It has been proved that gastric secretion and motility proceed after the extrinsic nerves have been severed, and thus the stimuli to these functions must arise within the organ itself, controlled to adaption according to the varying conditions present. This automatic action probably resides in the Meissner and Auerbach plexuses found in its coats. In the extrinsic nerves it has been shown that the motor-fibers are supplied by the vagus and the inhibitory fibers by the splanchnics. Through their activity the movements of the stomach may be influenced favorably or unfavorably according to conditions which directly or indirectly affect the central nervous system. This is important to remember in connection with the effects of corporal pain and the emotions (worry, anxiety, distress and rage) on secretion and motility.

#### SENSIBILITY OF THE ALIMENTARY TRACT.

The mucous membrane of the alimentary canal from the upper end of the esophagus to the junction of the rectum with the anal canal is insensitive to tactile stimulation. The mucous membrane of the esophagus and the anal canal is sensitive to thermal stimulation, but that of the stomach and intestines is insensitive. The mucous membrane of the esophagus and stomach is insensitive to stimulation by dilute hydrochloric acid and dilute organic acids, and the rectum, but not the anal canal, is insensitive to stimulation by glycerine. Contact of alcohol with the mucous membrane of all parts of the alimentary canal gives rise to a sensation of heat. The sensation of fullness in the alimentary canal is due to a slow increase in the tension exerted on the fibers of its muscular coat, the adequate tension is constant for each segment, but the volume of contents necessary to produce this tension varies with the tone of the muscle fibers. The only immediate cause of true visceral pain is tension. This is exerted on the muscular coat of hollow organs and on the fibrous capsule of solid organs. The sensation of pain in the alimentary canal is due to a more rapid or greater increase in tension on the fibers of its muscular coat than that which constitutes the adequate stimulus for the sensation of fullness. Pain, in diseases of the alimentary canal, is most frequently true visceral pain. It is sometimes due to spread of the disease to surrounding sensitive structures or to tension exerted on the peritoneal connections. It may also be situated in the skin, muscles and

connective tissue, to which it is referred from the segment of the central nervous system, which receives the afferent nerves from the affected organ. Tenderness in diseases of the alimentary canal is most frequently due to hyperalgesia of the skin, voluntary muscles, and connective tissues supplied by the segment of the central nervous system, which receives the efferent nerves from the affected organ. It may also be due to the increase in tension within the organ produced by the external pressure giving rise to an adequate stimulus of visceral pain; this is rare in the stomach, but comparatively common in spasmodic conditions of the colon and in appendicitis. Lastly, it may be due to the spread of the disease to the parietal peritoneum.

Visceral sensibility is exaggerated by training in hypochondriasis and visceral and referred sensations are exaggerated by the irritable condition of the central nervous system in neurasthenia and anemia.

#### HYDROCHLORIC ACID OF GASTRIC JUICE.

It is now definitely settled that the acidity of normal gastric juice is due to the presence of free hydrochloric acid. This was first demonstrated satisfactorily by Schmidt (1847) who proved that the precipitation of the contained chlorides in gastric juice by the silver nitrate method, showed that the total amount of chlorides was greater than could be held by the bases present in the secretion—thus, some of the chlorine must have been present in combination with hydrogen as hydrochloric acid. That this acidity was due to a free mineral acid and not to an organic is proved by the reactions of the color tests; methyl-violet, which turns blue; congo-red, which is changed from red to blue; and OO tropeolin, from a yellow to a pink or red.

The percentage of hydrochloric acid in the gastric juice varies from 0.1 to 0.3 per cent. In the carnivorous animals, like the dog, it is considerably higher, 0.4 per cent. or more. The amount varies according to the period of digestion. In the beginning of the process, the secretion does not possess its full acidity owing to the fact that it is still scanty in amount, a portion of the acid being neutralized by the saliva taken with the food, and the alkaline mucus (gastric particularly), and also by the alkaline secretion of the pyloric end of the stomach (Heidenhain). During the course of digestion its acidity may reach (Hornborg) to 0.4 or 0.5 per cent. The author believes that the latter figures are nearer to the amount normally secreted than are those first given (0.1 to 0.3 per cent.). His belief is based mainly upon a series of observations made upon three athletic young men

who apparently had normal digestions. They were given both the simple (Ewald) and the mixed meals (Riegel), which were extracted on different occasions at ten to twenty minute intervals, and examined according to the Hayem and Winter method of estimating the total chlorides. My percentages ran quite uniformly in each individual, from 0.30 to 0.45 per cent. At the beginning and the end of gastric digestion the percentage of acid secretions were markedly lower. As a rule 0.3 per cent. represents the average in test-meals, the lower amount due to neutralization by mucus and regurgitation from the duodenum. The acidity of the empty stomach is about 0.2 per cent. and the amount runs from 30 to 50 cubic centimeters.

The hydrochloric acid of gastric juice acts in a number of different ways, all of which are of great importance to the normal process of digestion. It is antizymotic and antiseptic, because it prevents abnormal fermentation and destroys pathogenic organisms which enter the stomach with the foods (Koch, Falk, Macfadyen and others). That this property of the acid is of great value as a safeguard to the economy from infections is plainly obvious.

A well-nourished young woman of twenty-five years was under my observation some time ago, who, three years before, had contracted typhoid fever of a severe degree. She had, when I first saw her, a hypochlorhydria of about 0.05 per cent., which failed to make any definite or sustained increase in the face of all methods of treatment. On a diet which seemed most suitable to her low gastric acidity and which kept her free from abnormal gastric fermentation after her meals, she went to a seashore resort in New Jersey, where she again contracted typhoid. Three years after this she developed intestinal tuberculosis presenting upon examination palpable mesentery nodules (no doubt tubercular), and she finally succumbed with a tubercular peritonitis. I feel that the persistently low acidity of her stomach had to do with the susceptibility of her intestinal canal to this infection.

Hydrochloric acid has the property of activating the pro-enzyme of the stomach (pepsinogen) into the active enzyme (pepsin) according to Langley in one minute and to a general extent. Because organic acids can also activate the pro-enzyme (not so quickly or thoroughly) it is probable that a chemical union of the hydrochloric acid with the pro enzyme does not take place—just, that an acid media is essential for its conversion into the active form.

Hydrochloric acid is probably of service in regulating gastric peristalsis, and in effecting the opening and closing of the pylorus for the exit of the chyme.

After activating the pro-enzyme of pepsin, hydrochloric acid assists materially in the conversion of the protein into an acid albumin, and then continues this on through the intermediate stages of

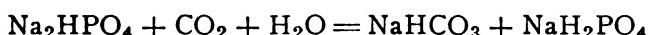
proteolysis until the peptones are formed. Pepsin, however, is an essential element in this process.

Hydrochloric acid has the property of converting cane into invert sugar (dextrose and levulose) which is a more readily digestible product for the upper enteric canal.

And lastly, hydrochloric acid is an important stimulant of pancreatic secretion (Dolinsky<sup>7</sup> and Walter<sup>8</sup>). This secretion, under normal conditions, depends upon the acidity of the chyme in its passage through the upper part of the duodenum. The secretion is brought about reflexly by the free acid; and thus the influence of the acid in this most important part of the entire digestive tract.

The presence of hydrochloric acid in the stomach is striking because it is the only instance of a secretion of the body that contains a free or a mineral acid. It is generally believed that the border cells of the gastric tubules constitute the acid secreting cells. This belief is based upon the fact that, in those parts of the stomach in which these cells most fully abound—the body and fundic end of the stomach—the secretion is distinctly acid, and where they are absent (pyloric end) the secretion is alkaline. Important also in this connection are the post-mortem observations of Hemmeter<sup>9</sup> in cases of pronounced and persistent hyperchlorhydria that have died from intercurrent diseases. In serial sections of these stomachs it was found that in the intermediate zone and fundus, the acid (as well as the central) cells were increased in numbers.

With regard to the origin of the acid, as none exists in the blood, it must originate from the secreting cells in the gastric tubules and that the chlorides of the blood most probably supply the HCl content of the gastric juice. Just how this comes about is still in the field of debate in which the hypothesis of Maly seems the most acceptable. According to this author the blood is an alkaline fluid due to the presence of the two acid salts of phosphate of soda ( $\text{Na}_2\text{HPO}_4$ ). The blood contains an excess of carbonic acid ( $\text{CO}_2$ ), which, acting upon the disodium phosphate produces monosodium phosphate:—



The chief chloride of the blood is sodium chloride ( $\text{NaCl}$ ), and the chlorine of this is set free according to the following equation:—



In support of this it has been shown that if the chlorides in the blood are reduced by removing them from the food for a sufficient length of time, the secretion of gastric juice no longer contains hydro-

chloric acid, although organic acids may be found present. Until it can be proven that the above hypothesis is not correct we must be content in believing that in the acid-forming cells the neutral chlorides (sodium chloride) of the blood are broken up liberating HCl upon the free surface of the stomach.

#### PEPSINOGEN AND PEPSIN.

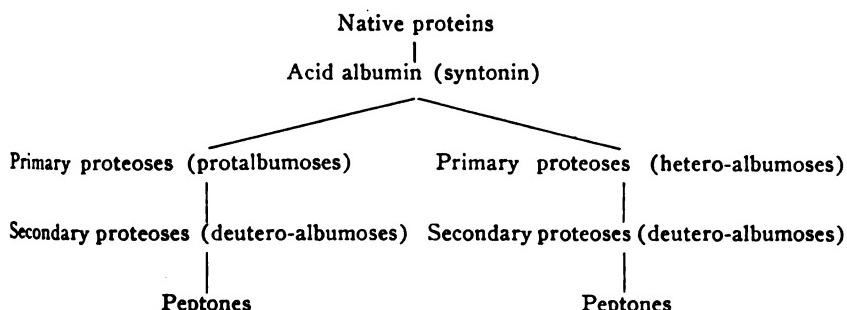
Pepsin is a typical proteolytic ferment acting only in an acid media. In the presence of the hydrochloric acid it converts albuminoid bodies into peptones and deprives gelatin of its jelly-forming property converting it into gelatin-peptone. Hydrochloric acid is the most able adjuvant to the combination of pro-enzyme and acid, other mineral and organic acids being decidedly less active and perfect in this regard. The exact chemical nature of pepsin is still unknown, although it is believed to be a protein or protein-containing body. As it does not contain phosphorus in its chemical make-up it does not belong to the group of nucleo-proteins.

Pepsinogen can be readily extracted from the glandular membrane of the stomach where it is formed by the chief or central cells. As a product, it differs from pepsin itself by its slow destruction by an alkali (sodium carbonate) and its high power of resistance. Its secretion is rarely destroyed even by marked pathological changes in the stomach (chronic catarrh, and sometimes even in carcinoma). It is secreted by the glands in all parts of the stomach, even in the alkaline pyloric region. One may believe that it is the true secretion of the central cells which the hydrochloric acid makes functionally active by supplying to it the best acid for the action of its proteolytic properties. Pepsinogen itself has little or no action upon the reduction of proteins in digestion.

Solid proteins when exposed to the action of a normal or artificial gastric juice swell up and eventually pass into solution. The soluble product thus formed is not coagulable by heat (like native proteins) and is remarkable for its diffusing properties, even beyond that of other forms of soluble proteins. To the end-products of pepsin-hydrochloric digestion of protein and gelatin substances is given the name of peptones.

The process of reduction from native proteins to peptones is complicated, and because of the rapidity of the changing and combined compositions it is difficult to determine exactly the chemistry of the intermediate products. The first step, however, is the change of the native protein to an acid albumin called syntonin. This change is brought about by the acid, but mostly and more quickly so by the

action of the pepsin-hydrochloric acid compound. As syntonin it remains in solution in both an acid or alkaline media but is precipitated in the presence of a neutral reaction, and thus it has also been called the neutralization precipitate. Continuation of the activity of the gastric juice causes the syntonin to pass into a further state of hydrolysis, and it is then no longer precipitated in the neutral media. The product at this time is a combination of bodies, which, as a group, are designated the primary proteoses (albumoses), and with which are found minute quantities of peptone (Kühne). This group of bodies, the proteoses further reduce to a group called the secondary proteoses (deutero-albumoses). As compared with the primary proteoses, the secondary ones are distinguished by a greater solubility, and they are more resistant to precipitation by the neutral salts. The secondary proteoses undergo still further hydrolysis in the production of the peptones. In order to make these relationships clearer the following schema is offered:—



The peptones are the most soluble substances of the group of compounds formed in peptic digestion. They are proteins which react to the biuret test, but are not coagulable by heat nor precipitated when their solutions are completely saturated with ammonium sulphate or any of the agents ordinarily used in tests for albumin (nitric, acetic, picric acids, potassium ferrocyanide, hydrargyro-iodide of potassium).

The various products between the native proteins and the peptones are distinguished by Neumeister by the following reactions: The primary proteoses may be precipitated from neutral solutions by means of sodium chloride; a neutral solution of secondary proteoses remains perfectly clear, a precipitation occurring, however, upon the addition of an acid. Potassium ferrocyanide, acetic acid, neutral solution of copper sulphate and an excess of picric acid precipitates the primary proteoses with but little more difficulty than the native

albumins. On the other hand, the secondary proteoses react but very slowly to acetic acid and potassium ferrocyanide.

The above represents the reactions of definite products of protein conversion. But in the examinations of the end or the transmission products, as they are found in test-meals, these reactions are not of practical value. The results obtained are usually obscure and indefinite, and it is but seldom that one can estimate which of these constantly changing products are present and in the largest quantities. The difficulty lies in the combinations that exist at the same moment—from the native albumin to the peptones, all grades of the converted products are mixed together—and these represent (Howell<sup>10</sup>) a hydrolytic cleavage of the protein molecules of a weight from 5000 to 2000 in the native proteins down to the much smaller and more soluble molecules whose molecular weights are perhaps only 250 to 400 or less. The nearest approach to the estimation of the proteolytic power of the gastric juice is by means of the indirect tests (Mett, Brücke, and Grützner), in which the conversion power then existing in the obtained juice is estimated, and not the naturally formed products that are already present in the test-meal.

#### RENNIN-ZYMOGEN AND RENNIN-FERMENT.

Rennin-ferment, rennet, or chymosin was supposed to exist in the human stomach from early childhood. As far as our knowledge went, the action of this enzyme was confined to milk, which it coagulated, precipitating its casein in neutral solutions. As milk and milk foods form an important article of diet in the human being, the action of this enzyme, if there be one, is important. It was supposed that the action of the rennin went no further than the coagulation of the milk. After this, the digestion of the curd was carried on by the pepsin, and in the intestine by the trypsin with the ultimate formation of peptones as in the case of all proteins.

"Rennin" causes milk to clot with great rapidity. In the case of cows' milk the entire milk becomes fairly solid, after which, if undisturbed, the clot shrinks and presses out a clear yellowish fluid called whey. With human milk the curd is less firm and takes the form of loose flocculi. The process in cows' milk resembles the clotting of blood. The rapidity of the clotting varies inversely according to the amount of rennin present and the temperature of the milk. Its action seems to require the presence of the soluble calcium salts; in the absence of these, milk does not curdle upon the addition of rennin, but will with pepsin and acid. The foregoing facts are important to

remember, because they form the basis for qualitative and quantitative estimations of "chymosin" and its supposed pro-ferment substance, or for the peptogenic power of the gastric juice as is suggested below. It should be added, that casein is also precipitated from milk by the direct addition of an excess of acid, or by the effects of bacteria upon milk-sugar (lactose) when they cause the formation of sufficient quantities of lactic acid to effect precipitation.

Like pepsin, "chymosin" was said to possess a previous stage known as rennin-zymogen or lab-zymogen and this, when treated with acids, is rapidly converted into the active form of the ferment. Also like pepsin, the rennin-ferment is destroyed by alkalies, even in weak solutions; whereas the rennin-zymogen, like pepsinogen, remained practically unaffected.

Because observers have not succeeded in extracting rennin, or its prodrome, from the mucosa of the pyloric region of the stomach, it is supposed to be secreted only in the fundic end and intermediate regions of the organ. The source of this secretion is, in all probability, the same as that of the pepsinogen, namely, the central cells of the gastric tubules. Boas<sup>11</sup> claims that rennin-enzyme is not at all affected by pepsin, saliva, or fat, and only by bile in so far that it deprives the gastric juice of a portion of its acid and thus interferes in the conversion of pro-enzymes into active enzymes.

With Cohnheim, Pawlow and others, it is my belief that there is no distinct milk curdling ferment in the human stomach, and that this clotting is accomplished by the pepsin alone as a preparatory step in the digestion of casein. As proof of this is the fact that milk curdling always takes place by the addition of pepsin and acid to fresh milk (rapidly when an acid is also present, and more slowly but still definitely when it is slight), and also the fact that the isolation of this enzyme up to the present has been impossible.

Brown, of Johns Hopkins, believes that rennin is a distinct ferment and presents the following: "There are many arguments in favor of their being different, as, for example, that pepsin acts only in acid, rennin in acid, neutral or slightly alkaline media, and the variation in the viability of the two ferments. Dr. Schnack has carried on under our direction a series of experiments in this connection, estimating pepsin by the Mett method, rennin by the Boas procedure, hydrochloric acid by the use of Töppfer's reagent, and the total acid with phenolphthalein as indicator in a series of 51 cases, the gastric contents being either that aspirated after the ordinary Ewald test-meal, or from the fasting stomach. These studies show beyond question that although, as one would expect, the pepsin and rennin content are parallel in most cases, nevertheless there

are so many exceptions to this as to prove clearly that the production of one enzyme may be suppressed or increased without affecting the production of the other; in other words, demonstrating that pepsin and rennin are separate enzymes."

#### LIPASE.

Lipase, or the fat-splitting ferment, is a product of the normal stomach in man (Volhard<sup>12</sup>). It strongly resembles the steapsin of the pancreatic juice and acts most readily upon emulsified fats as they appear in some of the natural foods, such as milk, cream and yolk of egg. The ferment, like pepsin, is secreted mostly from the fundus, but not at all from the pyloric end. As its action is destroyed by weak alkalies, and a prior formed substance to the actual ferment is but difficultly destroyed by it and then only by a considerable amount of caustic alkali; thus it is probable that a zymogen also exists for this ferment. The hydrochloric acid does not seem to be necessary for the conversion of fats, for this ferment works as well in neutralized gastric juice, but alcohol destroys its function. The content of its hydrolytic power on emulsified fatty natural foods has been computed to run as high as 70 per cent.

Much of the digested fat of foods undergoes practically no change in the stomach. Regarding the fat of meat for instance, this is set free from the cells by the dissolving action of the gastric juice upon the proteins, the fat existing in mixture with the other foodstuffs. The fat is then liquefied by the heat of the body and disseminated through the chyme in a coarse emulsion by the movements of the stomach. In this way it is mechanically prepared for saponification and emulsification by the pancreatic juice in the small intestine.

#### MUCUS.

The mucus that is found in the stomach contents is a composite mixture of that formed by the epithelium of the stomach (gastric mucus), and the secretion from above in the mixed saliva, mouth, throat and esophageal glands. While mucus and saliva which had been swallowed during a meal can usually be found in test-meals as foamy masses floating on the top; nevertheless, much of the swallowed mucus becomes thinned and intimately mixed with the gastric variety.

As a result of several observations that I made on a patient who had been fed on identical meals of a semisolid nature (at one time in the normal way of mastication, insalivation and deglutition, and at others through a stomach tube into the empty stomach so that the

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meal did not come in contact with the mouth, throat and esophagus) I observed that after carefully skimming the clumps from the swallowed meals, the amounts of mucus intimately and inseparably contained in the meals were perceptibly increased in quantity in the meals that had been delivered into the stomach by way of the stomach tube.

The presence of mucus is evident to the naked eye by its stringy and tenacious character. That of the gastric epithelium is usually

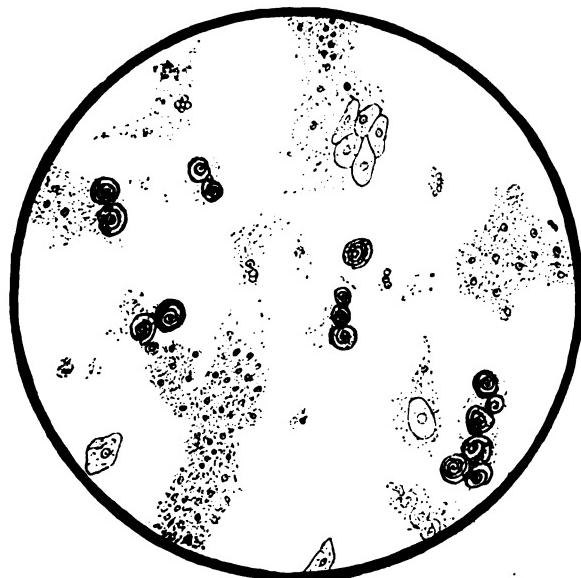


Fig. 9.—A specimen of gastric content aspirated from a patient in a fasting condition, showing the snail-like cells from mucus, singly and in groups, mucus and mucous corpuscles, some squamous epithelial cells, and amorphous material.

mixed with the food (incorporated mucus), and if separated from the meal sinks in standing water, while that from the pharynx is separate and floats on top. The normal stomach secretes but a small amount of mucus, and when the incorporated form is increased by gastric digestion it is pathological and indicative of gastritis. The highest degree of admixture is seen when the hydrochloric secretion of a stomach is absent or low (long-standing gastritis, carcinoma). On the other hand, little or no increase is observed in acute ulcer, the neuroses, hyperacidity and hypersecretion, the atonies, and benign stenoses of the pylorus. In the acid form of gastritis (*gastritis acida*)

where the secretion of hydrochloric acid is high, the amount of gastric mucus is usually quite large.

Mucus is dissolved or digested by gastric juice, but it requires twice as long as albumin for its solution (Schmidt<sup>13</sup>). According to the amount of HCl present and the period of digestion, gastric mucus is found in glassy transparent masses or as shreds or fibers. Very small, still fairly well defined corpuscles are found in the fibrillary base structure (mucous corpuscles), together with many free nuclei, which probably are the digested remains of the corpuscles and epithelial cells, the nuclear membrane being more resistant. Pavement epithelium with it suggests its origin from above the stomach, and ciliated columnar cells from the respiratory tract, upper pharynx or posterior nares.

The occurrence of snail-like cells was first described by Jaworski.<sup>14</sup> They are of no pathological significance and I agree with Boas<sup>15</sup> that they are commonly found. They are resulting formations of mucus which had been acted upon by HCl or fungi.

#### NORMAL FERMENTATION.

Swallowed with the foods into the stomach are various micro-organisms, which, under the favorable influence of the low acidity of beginning digestion, rapidly multiply and cause slight fermentation of the carbohydrates with the production of gases. This fermentation continues, with a slight addition from the proteids, until the height of acidity is reached when it is inhibited. The normal stomach in the height of digestion of a meal contains none or only a trivial amount of gas, and when this is present, it is always at the fundus until the organ has quite emptied into the duodenum, when the gas may also pass through the pylorus in small quantities, although it is usually retained in the stomach undergoing more or less absorption or ejection by eructation of all but a small quantity which always remains. More or less gas or air is residual in the lower esophagus, and on the swallowing of food this is passed into the stomach. Analysis shows that the one or two belchings of gas after meals is that of swallowed air. This act is a true reflex and is brought about by an inhibition of the normal tonic contraction of the cardia when the intragastric tension reaches 25 centimeters of water (Kelling).

The commonest organism in the production of fermentation is the lactic acid bacillus. It splits the sugar of milk into lactic acid also carbonic, acetic, formic, succinic and perhaps butyric acids. More or less hydrogen is also formed. The bacillus also possesses

the properties of inversion, and the power of splitting cane sugar and mannite into lactic and carbonic acids. A number of other micro-organisms also exist which are capable of forming lactic acid in the stomach.

Butyric acid fermentation is due to various forms of bacteria. These are of the anaerobic variety, the example of which is the rod-shaped bacillus butyricus the spores of which are found in a variety of shapes (Prazmowski<sup>10</sup>). As butyric acid fermentation occurs in milk after lactic acid has first been formed, it is possible that it might be one of the steps downward from the reduction of lactose to carbonic acid and hydrogen.

Acetic acid fermentation may occur by the action of the fungus of acetic acid (*mycoderma aceti*) upon alcohol, by the production of aldehyde which undergoes oxidation and forms acetic acid. This type of fermentation is usually found in those who partake of alcoholic beverages at meal times. It may also take place indirectly by yeast fermentation of carbohydrates.

Yeast fermentation depends upon the presence of the various forms of *saccharomyces* which have the property of splitting up glucose and forming alcohol and carbonic acid. As the yeast fungi are found in all breads, rolls and so on, and these foods are so generally partaken of at meals, and as hydrochloric acid in the quantities usually found in the stomach has no effect upon this process of fermentation found in normal stomachs, the author believes the lactic acid fermentation to be the commonest type of fermentation found in normal stomachs, and the acetic and butyric acid (and no doubt other types) come after.

The type of fermentation that is most prevalent in normal individuals is due to the character of his foods and drink, and somewhat to his eating habits. It is evident that combinations of the above mentioned fermentations could exist at the same time in a stomach.

#### ABSORPTION.

In the stomach the following food substances are possible of absorption: Water, salts, sugars and dextrins, that may be formed from the salivary digestion of starch or swallowed as such, and the proteoses and peptones formed in the peptic digestion of proteins or albuminoids. In addition there is absorption of soluble liquid substances, such as alcohol, drugs, etc. On the whole it may be stated that absorption from the stomach is nothing like so complete or quick as that from the intestines.

Water taken alone is practically not absorbed in the stomach, but in the intestines. Von Mering has shown that as soon as water is introduced into the empty stomach it begins to pass into the intestines by a series of spurts, caused by the contractions of the stomach, and in a short time the stomach is empty. With other fluids, however, this does not take place, but the more concentrated they are the greater is the degree of absorption.

The absorption of salts from the stomach depends upon their degree of concentration. According to Brandl, sodium iodide is absorbed very slowly or not at all in dilute solution. In solutions of 3 per cent. or over the absorption becomes important. This is probably true of the other salines, and, as saline solutions of 3 per cent. or over are seldom taken by the human being, it may be stated that the degree of saline absorption in the stomach is small or not at all, unless condiments, alcohol, etc., are present at the same time, when it is much facilitated (in this case the absorption is due to gastric congestion or stimulation of the epithelium).

Sugars, peptones, mucus, gelatin and vegetable gums are absorbed from the stomach, but not completely and only poorly so. Brandl's investigations proved that only about 5 per cent. of the peptones were taken up by this organ and at the end of two hours. Dextrose, lactose, saccharose (cane sugar), maltose and dextrin are absorbed, but also far short of completely. Brandl reports that sugars and peptones are not absorbed until in strengths of solutions of 5 per cent. or over; on the whole then, it may be said that food products are absorbed with some difficulty.

Fats are not absorbed from the stomach, neither in the saponified or emulsified form, including that acted upon by the lipase, or when in the more fluid state. Alcohol is absorbed most readily (even 20 per cent. solutions), but most of the medicaments (strychnine, etc.) but very poorly (Meltzer).

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## CHAPTER III.

### Physiology and Chemistry.

(Continued.)

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SINCE Pasteur's brilliant work on fermentation, ferments have been divided into two great groups; the living or organized ferments, such as yeast, bacteria, etc., and the non-living or unorganized ferments, such as pepsin, trypsin, etc. To the latter Kuhne has given the name of enzymes. Buchner (1897) showed that unorganized ferments existed in yeast cells and in lactic acid producing bacteria, and so it is most probable that in the case of organized ferments the action of these living bodies was due to a specific soluble product of them rather than to a direct product of the life metabolism of the cells themselves.

At the present day, the most tenable theory of the nature of enzymatic processes is that they produce in some mysterious way changes similar to catalysis. A catalyst is a substance that alters the velocity of a reaction, but does not initiate it (Howell<sup>1</sup>). It is therefore assumed, that the enzymes of the body act as catalysts of inorganic origin.

#### SPECIFICITY OF ENZYMES.

The main feature of the action of enzymes is that they are specific. Those that affect the proteins are not capable of action upon the carbohydrates and *vice versa*. The fat-splitting enzyme is likewise specific. It is believed to-day, that each substance has its own specific enzyme to convert it, and that the normal body secretes them as demanded. The pancreatic juice, for example, splits proteins, starches, fats and curdles milk, and there are assumed to be separate enzymes present to do this, namely, trypsin, diastase, lipase, and rennin, although here, as with the pepsin, a specific enzyme for curdling milk is not present. The fact that even the closely related substances like double sugar require more than one enzyme to reduce it—one for maltose and another lactose,—that all enzymes are capable of reversible reactions (lipase), that so little is known of them as definite substances, and that different ones are multiplying in such large

numbers, rather suggests the presence in the body of a father body for them all. Fisher has advanced the theory that the specificity of the different enzymes is related according to the geometrical structure of the substance acted upon.

The enzymes themselves are organic substances of a colloidal nature. They are formed from the living tissue, and solutions of them usually give protein reactions. Their structure is separate and distinct from the proteins, for they have been separated from their close protein association and still show their specific activities.

#### ENZYMES CONCERNED IN THE PROCESS OF DIGESTION.

<i>Enzyme.</i>	<i>Where found.</i>	<i>Action.</i>
Act on carbohydrates.	Ptyalin.	Converts starch to maltose sugar.
	Amylopsin.	Converts starch to maltose sugar.
	Invertase.	Converts cane sugar to dextrose and levulose.
Act on fats.	Maltase.	Converts maltose to dextrose.
	Lactose.	Converts maltose to dextrose and galactose.
	Lipase.	Splits neutral fats to fatty acids and glycerin.
Act on proteins.	Steapsin.	Splits natural fats to fatty acids and glycerin.
	Pepsin.	Converts proteins to peptones and proteoses.
	Trypsin.	Splits proteins to the crystalline product for absorption.
Erepsin.	Small intestine.	Splits peptones for absorption.

#### REVERSIBLE REACTIONS.

Accepting the enzymes as catalysts, it is probable that, as with certain chemical substances, they are capable of opposite changes toward an equilibrium—that is, that they may proceed in two directions until a new equilibrium is established. An interesting example of this is the double effect of lipase (Kastle and Loewenhart<sup>2</sup>). These authors showed that lipase causes not only an hydrolysis of ethyl-butyrate into ethyl-alcohol and butyric acid, but that a synthesis of the last named substances could take place into ethyl-butyrate and water. The presence of this reaction in the tissues of the body offers

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the structures of the body, to build up and maintain the equilibrium of weight, and to supply the adult, foods, in solid or fluid forms, which arises in the general body but especially in the organs concerned in the process of assimilation, and the stomach most of all. A primary manifestation may be designated as hunger. In the usual individual habits in the way of quantities of food, drink, and so on, make differences among individuals. Hunger is a passionate longing, real and insistent, especially in children. Added to the organic foods, water and air are necessary to meet the sensation of thirst, and act as auxiliaries for their digestion, absorption, assimilation, and excretion. Thirst is also of corporal origin, manifested especially in the mucous membrane of the pharynx.

In a normal person in whom the desire for food exists, the process may be described briefly as follows. The thought of food, the smell and sight of its cooking, and its appearance before him initiates the process of digestion (psychical). Added to this now comes the effects on salivary and pancreatic secretions brought reflexly about by the stimulation of foods through sensations of taste and smell. As the molars grind and compress the food in mastication, the ptyalin begins its work upon the raw starches or raw starch flour which had been freed from the cement of its granules and thus is capable of absorbing water. The fluid saliva renders the food more pulmaceous, and the mucus added to it from the mouth glands and lower salivaries lubricates it. After this, the dorsum of the tongue presses it backward into the mouth of the pharynx, from which it descends into the esophagus, where, by peristaltic movement, it is delivered through the cardia into the stomach.

Already, the stomach is at work secreting gastric juice to meet this bolus, which beginning gastric motility distributes throughout the organ. As the meal continues, the vascular supply to the mucosa increases, causing it to take on a pinkish hue, and the flow of gastric juice increases in quantity from the direct stimulation of the food on the secreting apparatus and the action of the secretagogues. The juice, with its hydrochloric acid and enzyme, discharges from the tubules on the free surface of the stomach, and the inclined shape of the walls of the stomach with the assistance of gastric peristalsis encourages the juice to run towards the pyloric end and mix generally with the food in that area, causing quick proteolysis, the splitting of the emulsified neutral fats, inhibiting the action of the ptyalin, and adding sufficient acidity to permit of the opening and closing of the pyloric sphincter so that the prepared chyme can be sent at regular intervals into the small intestine.

As the organ continues to fill with food, the meal stratifies itself in the axis of the viscus away from the acidified chyme at the surface and pyloric region. In the pyloric and intermediate portions, active peristalsis and shortening of the organ work the chyme onward, while the fundic end and cardia hold the food in a tonic grasp to further permit the ptyalin of the saliva to continue the reduction of the starches present. Depending upon the character and amount of food ingested, the acid enzymotic content of the gastric juice raises (adaptation juice) until it is sufficient in concentration.

At about the middle period of gastric digestion, the entire mass is markedly acidified and the conversion of starches has ceased. The organ is now in active motion, and some of the water, salts, peptones, and dextrins are being absorbed. The manufacturing of gastric juice now gradually declines toward a point of non-secretion, and less mucus is being delivered from the gastric epithelium. The strength and activity of the peristalsis of the stomach diminish as the organ empties, practically ceasing when this is completed, and after which the gastric mucosa returns to its alkaline and gray-colored appearance.

From the first entrance of the chyme into the duodenum, more important and interesting physiological phenomena take place. In the small intestine the digestion is profound and the resulting products mainly absorbed. This begins at the pylorus and is largely completed by the time the food arrives at the ileocecal valve. The digestion in this part of the canal is effected by the combined action of the three secretions—pancreatic juice, secretion from the intestinal glands (*succus entericus*), and bile—all of which continue hand in hand.

maintain life in its fullest capacity, all of them are necessary. It must never be forgotten that while man may exist on a one-sided diet (vegetables), it is not altogether what we eat but what we digest and absorb that maintains the exothermic changes of life, and also the important fact that the proteins of animal foods are more completely digested than those of the vegetable kingdom.

The animal foods, particularly the meats, are characterized by their large quantity of proteins and fats, and a relatively small amount of carbohydrates. The meats themselves differ considerably in their protein content as the following list shows. The vegetables are distinguished, as a rule, by their large percentage of carbohydrates and small amounts of proteins and fats. Some of them, however (such as peas, beans and other leguminous foods) are remarkable for their large percentage of protein. The cereals occupy a place between the two groups above mentioned.

COMPOSITION OF DIFFERENT MEATS. (Taken from Koming's and Atwater's analyses.)

	Water.	Protein.	Fat.	Carbohydrate.	Ash.
Beef, moderately fat .....	73.03	20.96	5.41	0.46	1.14
Veal, fat .....	72.31	18.88	7.41	0.07	1.33
Mutton, moderately fat.....	75.99	17.11	5.97	....	1.33
Pork, lean .....	72.57	20.05	6.81	....	1.10
Ham, salted .....	62.58	22.32	8.68	....	6.42
Pork (bacon), very fat .....	10.00	3.00	80.50	....	6.5

In the class of proteins are also included other substances than muscular tissue of animals, as various glands (thymus, testicles, spleen, etc.), brain, lung, liver, and so forth. Birds and fish foods, oysters, clams, lobsters, etc., are included in this class. The digestibility of the protein foods depends much upon their quality, quantity ingested, and preparation. The younger animals supply the tenderest and easiest digested flesh. That which is too fresh (still rigid) or contains much fascia, tendons, etc., is tougher and more difficult to digest. Raw meat is more easily digested than that which has been cooked; and chopping, scraping, or grinding the meats increases the digestibility. Cooking, however, diminishes the danger of infection by the destruction by heat of the contained micro-organisms. As the cooking of meats coagulates their nitrogenous matter (myosin) and contained blood, it must be evident that any extract of these foods, when heat is used in the process (beef-tea, other meat and fish food broths), contains but little protein matter and therefore is quite valueless as a food. Unless some of the carbo-

which color the chyme a yellowish-green tint) and a substance which facilitates in the entire digestion of fats. The abundant presence and action of the bile retard the putrefactive changes of the food in the small intestine caused by the bacteria normally present.

Absorption of all of the end-products is now active; the fats by way of the villi, lacteals and thoracic duct into the blood vascular system, and all the others through the capillaries of the villi into the portal vessels and by way of the liver finally into the blood. When the chyme has arrived at the ileocecal valve (from two to five and a half hours after eating) and while it is passing (from nine to twenty-three hours), about 85 per cent. of the food-products have been fully digested and absorbed.

The remainder of the meal is now in the large intestine, where it comes in contact with the alkaline and mucus-charged secretion of the colon which is free from enzymes. Here, that much of the unabsorbed food that has passed the ileocecal valve and the water of the chyme, which is still about as fluid as at the pylorus, are passed up and down the ascending colon by peristaltic and antiperistaltic movements and are absorbed, leaving feces, which consists of indigestible food materials, some of the food-products untouched by the intestinal secretions and some of the unabsorbed end-products, cholesterol, excretin, mucus, pigment, inorganic salts, a large quantity of bacteria, and the end-products of putrefaction (phenol, indol, skatol, cresol, etc.). It may finally be mentioned that there is normally a minor degree of bacterial action in the lower part of the small intestine; most of the putrefaction, however, takes place in the large. In the small gut there is usually some bacterial effect on the carbohydrates and also on the proteins if they are not quickly absorbed. The feces collect in the sigmoid and rectum, where its pressure upon the sensory nerves produces the desire to defecate, which is brought about by relaxation of the internal sphincter at the anal opening and the contraction of the abdominal muscles.

#### FOODS AND FOODSTUFFS.

As the body is composed of the chemical constituents or proximate principles of proteids, carbohydrates, fats, water and salts, in order that nutrition of the body may proceed normally, these principles in proper proportions and quantities must be supplied as food. This permits of the use of a great variety of products of the animal and vegetable kingdoms, and as man is an omnivorous animal and Nature has developed in him the physiological necessities to digest them to

legumin, which is allied in its chemistry to albumin. They form the chief source of nitrogen in the vegetarian dietaries. Some of them, like potatoes and rice, are relatively rich in starch and sugar. The green vegetables, asparagus, cabbage, spinach, string beans, etc., are especially rich in salts; while fruits, pears, peaches, grapes, apples, etc., all contain considerable sugar and organic acids, like tartaric, malic, citric, and others. Ground cereals make up a significant bulk of carbohydrate diet (wheat, rye, rice, barley, oats, etc.). Some of these, like oats, are rich in starches, while others, like wheat, contain a protein called gluten and fats in considerable quantities and are valuable nitrogenous substances. Those that contain mostly starches are ground up into flour, which in turn, by the addition of other substances, like yeast, carbonic acid gas, baking powder and so on, are developed into various articles of food (bread, cakes, biscuits, macaroni, sago, etc.).

Two factors largely determine the digestibility and absorption of foods in the process of digestion: The first is the bulk; the second is the cellulose content. The bulkiness of vegetable food interferes with digestion in two ways. The digestive juices have difficulty in penetrating such a mass so that the conversion of the constituents into products capable of absorption is apt to be quite inefficiently carried out, and the large mass has a tendency to hasten the intestinal peristalsis, the contents of the gut are thus pushed forward too rapidly; and even were digestion more complete, the absorption could not keep pace with the food movement. The presence of cellulose is the second great factor in the retardation of digestion and absorption. In the case of meat, the nutritive constituents are held in tubes composed of gelatin which readily digest; in the case of vegetables, the starch is contained in cubical compartments with walls of cellulose. Cellulose is a carbohydrate, belongs to the class of polysaccharids, and is especially characterized by its extraordinary insolubility. From this it can be seen that the presence of cellulose influences digestion and absorption in several ways. It not only has little or no food value of itself, but it prevents the access of digestive juices to the mass of food in the stomach, and it prevents the juices penetrating to the individual starch cells. Further, by increasing the mass to such an extent it has a tendency to stimulate the intestinal movements and hasten the progress of the food. The vegetables and grains that are especially high in cellulose content, are carrots, beets, cabbage, brussels sprouts, cauliflower, greens, kohlrabi, lettuce, rhubarb, tomatoes, rolled oats, oatmeal, cracked wheat and corn, and barley meal.

## COMPOSITION OF FOODS. (HOWELL.)

In 100 Parts.	Water.	Protein.	Fat.	Carbohydrate.		Ash.
				Digestibles.	Cellulose.	
Meat .....	76.7	20.8	1.5	0.3		1.3
Eggs .....	73.7	12.6	12.1			1.1
Cheese .....	36 to 60	25 to 33	7 to 30	3 to 7		3 to 4
Cow's milk .....	87.7	3.4	3.2	4.8		0.7
Human milk .....	89.7	2.0	3.1	5.0		0.2
Wheat flour .....	13.3	10.2	0.9	74.8	0.3	0.5
Wheat bread .....	35.6	7.1	0.2	55.5	0.3	1.1
Rye flour .....	13.7	11.5	2.1	69.7	1.6	1.4
Rye bread .....	42.3	6.1	0.4	49.2	0.5	1.5
Rice .....	13.1	7.0	0.9	77.4	0.6	1.0
Corn .....	13.1	9.9	4.6	68.4	2.5	1.5
Macaroni .....	10.1	9.0	0.3	79.0	0.3	0.5
Peas, beans, lentils .....	12 to 15	23 to 26	1½ to 2	49 to 54	4 to 7	2 to 3
Potatoes .....	75.5	2.0	0.2	20.6	0.7	1.0
Carrots .....	87.1	1.0	0.2	9.3	1.4	0.9
Cabbages .....	90.0	2 to 3	0.5	4 to 6	1 to 2	1.3
Mushrooms .....	73 to 91	4 to 8	0.5	3 to 12	1 to 5	1.2
Fruit .....	84.0	0.5		10.0	4.0	0.5

## ACCESSORY ARTICLES OF FOOD.

In addition to the ordinary foods, there are a number of articles which are frequently used but are not essential to maintain life. Among the most used of them are: alcohol and various drinks, tea, coffee, cocoa,—and the condiments.

Alcohol is used in a great variety of drinks. Beer contains from 3 to 5 per cent. of alcohol, and about 6 per cent. of extractives, prominent among which are dextrin, maltose and albuminoes. Wines contain from 6 to 25 per cent. of alcohol; port about 10, and sherry up to 25 per cent. In addition, the wines contain considerable sugar and free organic acids. Spirits contain about 50 per cent. of alcohol.

In small amounts and in dilution of under 10 per cent., ethyl alcohol acts as a stimulant to the secretion of hydrochloric acid, but no effect is noticed on the amounts of pepsin or gastric mucus. In stronger solutions, 20 per cent., the secretion of gastric juice is more actively stimulated with an increase in the production of mucus. In higher concentration the secretion is inhibited and shortened, while the formation of mucus is marked. Over 50 per cent. alcohol produces abundant mucous secretion with very little hydrochloric acid formation. Above 70 per cent. it has a corrosive action on the mucous membrane through its disintegrating effect upon the albumin in the cells. (L. Kast<sup>3</sup>).

Like alcohol in small quantities, tea, coffee, cocoa are all stimulants. This is due to the alkaloids contained in them. Tea has in

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~~agent of the nature of tannin. The alkaloid of coffee~~  
~~plus of caffeine in each cup) with a volatile oil~~  
~~this beverage strongly stimulating to the nervous~~  
~~system. Cocoa also contains fats (60 per cent.), starch~~  
~~water, and thus must be looked upon more as a food~~

~~iments are pepper, salt, mustard, vinegar, pap-~~  
~~lars, which are various oils or esters that give~~  
~~or drink. As a group it may be said of them~~  
~~an important place in the régime of feeding, and are~~  
~~of rendering foods more palatable. In the quan-~~  
~~they are usually taken they are not injurious, at least~~  
~~extent on the normal stomach.~~

## ~~NUTRITION AND HEAT PRODUCTION.~~

~~beginning this chapter it seems not amiss to include some of~~  
~~related facts concerning the aim of alimentation, metabolism,~~  
~~etc., and so on, as they appear of importance. For the~~  
~~difficulty in outlining these varied and complex processes, it~~  
~~is best to consider them under the foodstuff headings—such as~~  
~~albuminoids, carbohydrates, fats, water, etc.—and call~~  
~~certain general physiological conceptions regarding them.~~

~~The process of the metabolism of proteins (and albumin-~~  
~~for the purpose of tissue nutrition and repair incident to func-~~  
~~the organic substances are chemically changed, and nitrogen,~~  
~~which is a component of the original body, is eliminated. This is found~~  
~~in urine, feces, and sweat. When the body is receiving in the food~~  
~~nitrogen (or protein) as is metabolized and excreted, the body~~  
~~is said to be in nitrogen equilibrium. In adult life, under normal~~  
~~conditions, the diet is so regulated by the appetite, that a nitrogen~~  
~~equilibrium is maintained through long periods of time. If there is a~~  
~~plus balance in favor of food, the body is laying on or storing protein~~  
~~tissue; while if the balance is minus, the body is losing protein and~~  
~~therefore weight. In this connection, it is important to remember~~  
~~that under favorable conditions for its development, a body can estab-~~  
~~lish the nitrogen or protein equilibrium at different levels without any~~  
~~apparent effect for the time being. But a long continued too high an~~  
~~intake is liable to cause gastro-enteric and corporal conditions of~~  
~~illness; while one that would be too low would cause subnutrition,~~  
~~anemia, etc. During growth in the young, in convalescence, etc., the~~  
~~body stores protein and the balance is in favor of the food nitrogen.~~

Likewise it is important that the carbon equilibrium must also be maintained to preserve health in the body. The carbon is excreted in the exhaled air, urea, etc., and this output is also balanced by the carbon intake of the food. It is possible that a body could be in nitrogen equilibrium and yet lose or gain in weight, because the nitrogen intake and output may be balanced while the carbon, which is derived mostly from the fats and carbohydrates, may be greater or lesser as the case may be. A normal person lives so as to maintain a general body equilibrium (includes also water and inorganic salts).

His intake must balance his output so that he can carry on the functions of life and his mental and manual work without losing weight and strength. The non-protein foods can act as protectors to the proteins. Herein lies their great value in nutrition. On a mixed protein and non-protein diet, the latter may be increased and the former markedly decreased without there being a breaking down of the nitrogen equilibrium. This is apparent when we remember that the proteins furnish heat-energy to the body, and that parts of them are used to reconstruct the living protoplasm which breaks down in the functional work of the tissues. The non-proteins are strong heat-and work-energy furnishers, and, by saving this necessity on the part of the proteins, can permit them to enter mostly into the reconstruction of the tissues.

The examination of the dietaries of the civilized races shows that between 100 and 120 grams of protein are used daily by the average adult man. Chittenden claims, based on a number of careful observations, that Voit's standard of 118 grams was too high, and that men in various walks of life may be well nourished, without losing weight or strength, on a diet containing only 30 to 50 grams of protein. While this may be true and is of interest from a physiological point of view, it is wisdom for the physician not to set it up as a standard for application to those who are ill, unless he adds to the low protein dietary a sufficient quantity of easily digested "protein-sparers" to keep the protein quota high enough for full nutrition. In diseases like the continuous fevers and in some gastric disorders in which it might be advisable for evident reasons to seriously curtail for the time being the quantities of ingested foods (gastric atonies), the low protein standard might be of service as a safe minimum standard in making up a dietary. In many of the gastric disorders of an organic nature (non-malignant), the patients suffer from subnutrition from the taking of too little food, and a higher feeding of proteins, like that now successfully employed in the treatment of tuberculosis, constitutes an

important factor in the improvement of their general and local condition.

The albuminoid most frequently occurring in food is gelatin. It is derived from the connective tissue in meat, bones, etc. Observations have conclusively shown that although gelatin most resembles the proteins, and that it is formed into peptone during digestion, it cannot maintain nitrogen equilibrium. Gelatin serves as a source of energy to the body in about the same sense as the carbohydrates and fats do, excepting that it is a better protein-sparer than they are.

The carbohydrates, sugars, starches, gums, etc., are reduced in the processes of digestion and absorbed into the blood as simple sugars (dextrose, levulose, galactose). Here they are formed into glycogen, in which form they are stored in the muscular tissue and liver and finally are utilized in the economy as dextrose. Most probably the liver is the storehouse and regulator of this supply to the blood. Physiologists assume that in regulating this, the liver-cells produce an enzyme which converts the stored glycogen into dextrose in proportion as the sugar of the blood is used up by the tissues. The end products of carbohydrate oxidation are carbon dioxide and water, and the probability is, that in some way the internal secretion of the pancreas is essential to the process, of which it may be said that there is still much to be learned in the way of how this is brought about and the chemistry of the intermediate products.

The great value of carbohydrate foods lies in their being a source of energy for muscular work (the oxidation of the muscle glycogen furnishes the main or sole source of element for muscular contraction). By their oxidation they furnish a most important part of the constant supply of heat in the body (each gram of sugar on oxidation yields 4 calories of heat), and the oxidation of sugar saves the loss of protein. It is evident, then, that the carbohydrates are important sources of heat and energy, but have no direct effect upon the building of the protoplasm of the body. In fact a person fed only on strict carbohydrate food would eventually starve to death. There is little doubt that in the indirect way, as protein-sparers, they are more efficient than the fats. The carbohydrates again, are important factors in the building up of fat of the body, and the fat which is synthesized from them is of the firm and most staple kind. Since in the forms they are usually taken as foods they are so readily digested and absorbed, they comprise an important factor in the dietaries of those who are under nourished and debilitated—a common picture in many of our long-standing gastric cases.

As has already been pointed out, the fats are broken down in the process of digestion into fatty acid and glycerin, which two products are immediately resynthesized in the villi into neutral fat again, in which form it circulates in the lacteal system (the so-called chyle fat). The fats are the main sources of energy to the body—even beyond that possible by the same weight of carbohydrates. When eaten and absorbed in amounts in excess of the metabolic necessities, it is stored in the adipose tissue as fat which is readily available for oxidation for conditions of need, such as, insufficient diet, illness, starvation, etc. In addition to their sources of heat-energy, both immediately or after they had been stored, they may be synthesized with other complex substances of the body, such as lecithin. It is probable that they are not factors in the production of body sugar in any way, even under conditions of starvation. But on the other hand, fat can easily and often is produced from sugar in the body—this is plainly seen in those heavy individuals who practically live on fat-free diets, but who partake largely of carbohydrates.

The body contains in its structure a considerable amount of inorganic materials. On incineration of the body this amounts to about one per cent. of the total weight. These are not sources of heat-energy but, nevertheless, they have most important functions. They maintain a normal composition and osmotic pressure in the controlling of water to and from the tissues; they are bound up in the living molecule and are necessary for their construction and normal reactions; the calcium salts are important in the coagulation of the blood and the coagulation of milk; the calcium, sodium and potassium salts in the actions of the heart and irritability of the muscular and nervous tissues; the iron salts for the production of hemoglobin; and the chlorides for their assistance in osmosis, secretion and excretion.

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- <sup>2</sup> KASTLE AND LOEWENHART: American Chemical Journal, 24, 491, 1900.
- <sup>3</sup> L. KAST: Archiv f. Verdauungskrankheiten, 1906, xii, Nr. 6.

## CHAPTER IV.

Quamness.

In patient, the history taker's ability to select points and reject those which are superfluous in gastro-intestinal conditions, as well as it is hardly necessary to again state the consecutive history is of the utmost importance, what is selected in writing must always be relevant to the case and not include all that most patients tell us. It is remarkable that a lay person could delineate a consecutive history, but this ideal is rarely met with even when a physician examines the patient before us. Common errors, in my experience, in evidence on the part of the patient to direct attention to non-essential features, the tendency of persons to lay special stress upon unimportant matters, the rambling off in directions which do not assist in the way of assisting in the diagnosis of the condition, the bringing them under observation, and the ever present fact that the lay person is not observing of himself in the detail way and attaches no or but slight importance to many valuable clinical

For this reason, I usually begin the detailing of the history of the present illness with the question, "In what way do you seem to be distressed?" My purpose in this, is to serve in obtaining the presenting symptoms quickly and roughly distinguishing between gastro-intestinal conditions proper, and conditions of disease remote to the alimentary canal. While this is not offered as of practical value in the separation of the cases, it is of value as a time saver, and permits one to make mental deductions of the patient's appearance, manner, voice, his aptitude to center on symptoms, the listening to matters of history which might be the pivotal points for elucidating subsequent relevant details, and so on. I believe it is always the best plan to encourage this preliminary talk before the details of the building up of the present history record is begun in earnest. The majority of those seeking advice are quite willing to give a report of their distress at the onset of this part of the interview, which narration, it can be said, can easily be stopped by the simple interjection of a question or two should it be noted that

but little more of importance could come spontaneously. Quite naturally, the subjective symptoms receive the sway of attention on the part of the patient, and the objective ones, unless they are prominent features in the case, but scant notice. In a few moments, a general atmosphere of the case and the individual will be noted, and an idea will occur as to whether the patient's detail of symptoms can be accepted, or to what extent, or whether it would be wisest to request of the individual to simply answer the questions as you ask them. At this point the history is begun in detail, and the subject matter written upon history cards or blanks kept for that purpose. At the recording of the history it is well to become master of the situation and, having in mind the individual's past remarks as they bear upon the illness, build up the history in a deliberate manner. Manifestly, it would not be expected in this work to canvass the symptomatology of all of internal medicine. The author wishes merely to give a few simple guides with the hope that the matter of good history taking may be more generally recognized, and benefit accrue, at least insofar as it pertains to gastro-enterological conditions. My observation has been that assistants who have graduated from properly conducted hospitals—particularly those of our large cities—are more alive to the importance of good histories, and are more able in the construction of them than those who have not been so fortunate. This alone tells its own story, to which, of course, it must be added that personal equation makes differences in all. The following questions are offered in the way of suggestion:—

**Age, avocation and mode of life?**

Alive or dead, father, mother, brother and sister. Points on endocrine types.

Are you of a nervous nature? Points from direct observation of the patient.

What previous illnesses have you had? What were and are your habits in the use of alcoholic drinks, tea, coffee, and tobacco?

**Mode of onset of symptoms, sudden or gradual?**

Was there an infectious disease or any disturbed state of body accompanying or immediately preceding its onset? Any other cause, such as fright, worry, taking cold, trauma? When did your illness begin? What were the first symptoms noted, and how have these changed since then?

What is your usual weight, and have you maintained, lost or added to it? Always weigh patients yourself to prove that their statements are correct.

Have you lost in physical strength since your illness, and how have you noted it?

How is your appetite now? Is it regular, increased, lost, variable, easily satisfied, or have you a desire for piquant foods?

Is your thirst increased, and how do you feel after drinking hot or cold drinks?

Have you an unpleasant taste in the mouth? Is it pappy, sweet, sour, bitter

or foul? Is it only present or is it most noticeable mornings, or present or after meals, and if so, how long after?

What are your eating habits in numbers of meals, kinds of foods you partake the most of, and how much time do you usually take to eat your meals?

Do disturbances of swallowing or symptoms of dysphagia exist? And if find out their character. Is there a globus hystericus, or vomiting of foods collect in the esophagus? What kind of foods can be swallowed the easiest, or can't at all—solid, semisolid, fluid. Have you catarrh in the head, and do you have much throat trouble?

Have you a feeling of pressure or what sort of distress is there in your stomach? At what point do you feel it, does it come on only after eating, and how soon afterward, or is it independent of the ingestion of foods? How long does it last, and do foods and certain kinds of food or quantities of them have any influence upon it? Have there been periods of time in the past when it was not present?

Have you actual pain in the stomach, or just distress? What is its relationship to meals, quantity or quality of foods? When after eating does it occur, how long does it last, and exactly where is it situated? What is the character of the pain, and does motion or posture influence it?

Are you troubled with decided belching of gas, and what is its relationship to eating? Is it odorless or not, and has it a taste? Do small amounts of feces come up with the gas? How long does this last after eating, and have you had intervals of relief and return in the past? Is there trouble with gas or rumbling in the intestines?

Is nausea present, how long does it persist, what is its relationship to meals or an empty stomach, and how long have you had it? Do you vomit, if so, what have you vomited—ever blood, bile, mucus, fecal substance, etc.? When does it come on; after meals, between times, nights, or early morning? Is this vomiting a rather constant feature, or only rarely present? What have been the sensations in your stomach before and after it had occurred? Is it collective vomiting?

What is the condition of your bowels in the way of daily movements? What is the consistency, color, and character of your stools? Are the stools accompanied by pain? If diarrhea exists, how frequent and what is the character of the discharges? Do you have pain or rumbling when your bowels move? Does the diarrhea alternate with constipation? Do you ever pass mucus? If necessary examine the anus, rectum and sigmoid.

As was stated before, the above are only suggestions. As certain seemingly important symptoms are given, it is advisable to accredit them in a pivotal sense and seek by correlative symptoms to confirm or elaborate them. A primary rule of evident value is not to build up a history on symptoms that do not exist. Better by far to have a short succinct record than one in which the important points are lost in a mass of non-essentials. Exceptions to this may be made when negative record of large organs, cavities, or laboratory reports is to be included. That is to say, such brief terms as, "heart and lungs negative," "blood, urine, feces, sputum neg.," and so on, are permissible, but it

not present subjective and non-important personally noted objective symptoms, together with unimportant not-finds of your own, had best be left out.

The value of diagnostic points in the history is plainly evident, and it might further be said, that conversely, a disconnected, questioned, or barren history may be of confirmatory value when some of the commonly seen neurotic affections are under observation. Considering some of the important points in more detail with a general idea of their relative importance to diagnosis, the following is offered:

Age, and avocation are important factors. In infants, children, youths, and young girls, the gastro-intestinal affections due to indiscretions in diet are by far the most common. Most of these are of an acute nature and are simple catarrhal or toxic conditions in which the cause can easily be determined. Unhygienic factors pertaining to their mode of life, and general states of body are of course important, since it is true that the young are more susceptible to bad effects from errors in feeding than adults. The neuroses are most common in those of the second and third decade who are engaged in active life. Acute gastric ulcers of the clinical type are more common in those right after puberty and up to the third decade; chronic ulcers and carcinoma are usually seen later in life. Sarcoma of the gastro-enteron may occur at any time from puberty on. Chronic gastritis is mostly a disease of adult life, beginning at any period.

Family histories of tuberculosis, syphilis, cancer, early heart, kidney or renal conditions. The endocrine types giantism, acromegaly, dwarfism, obesity, imbecility, insanities, etc., are all important.

Avocation and mode of life have a strong importance in the history. In such patients as are daily employed indoors, bookkeepers, sales clerks behind counters, typewriters, seamstresses, sewing-machine workers in factories, and so on, from their sedentary employment are especially prone to constipation and conditions of low and perverted digestion. In the adult, sufficient manual exercise and fresh air are important factors in maintaining good digestion, assimilation, and metabolism. In the young and aged these may be said to be not so essential although still important. The same may be said of those in higher walks of life, such as business people who conduct their affairs from desk chairs, and men and women in whom employment in business is unnecessary to livelihood. Particularly in the women of the better classes, a medley of metabolic and neurotic disturbances exist because of the physically inactive and vitality-robbing lives that some live. Those who ride through life in carriages arrive quicker at the grave than those who walk. In such as these,

late rising, late retiring, and heavy eating are commonly present, and it is no wonder that such artificial existences should render the person more susceptible and beset with worry, anxiety, mental strain incident to social, domestic and physical affairs than in those less fortunate in the worldly way. Important also is it to recall that gastro-intestinal symptoms may be present in workers in metals, as moulders and finishers of soft metals, painters (lead), colored papers and artificial flowers (arsenic), also those subjected to inhaling coal gas or its products of combustion, and in the drug habitués, particularly morphineism. Among habitual "diners out," and "good fellows" of men, chronic gastritis, intestinal and metabolic disturbances are common. In constantly well-dressed women conditions of ptosis are often observed, even if they have had no children. In those whose work causes rather constant pressure upon the epigastrium (shoemakers, etc.) gastric ulcer may exist.

The acute gastric ulcer is the most common in women, and chronic gastritis in men. In women, ptosis and the true psychic and neurotic disturbances are more commonly found. According to my records, myasthenic and atonic states of the stomach predominate in men, while cancer is about evenly divided. Quite naturally those who racially, by family inheritance, or disposition, are of a "nervous nature" would be more prone to the neurotic and neurasthenic states, and the same holds true with those whose parents were alcoholic or syphilitic.

The value of history of previous illness is evident. Many digestive disturbances accompany, follow, or are made worse, by states of general illness. Also, of some service in the diagnostic, prognostic, and therapeutic way is a history of gastric disturbance in the past interspersed with periods of relief, for such are liable to be the more chronic affections. The state of the now present digestive disturbances should always be matched in character and severity of symptoms with those that were present in attacks before, and, as these may present differences, those of late changes or the establishment of resulting or new conditions, may be suggested. Excessive use of alcoholic drinks is very liable to result in chronic gastritis; excessive coffee and tea drinking in the local or general neurotic affections, and the heavy use of tobacco in the irritative sensory, secretory and myasthenic states and in general neurotic and circulatory disturbances.

Mode of onset is of value particularly in the suddenness of acute ulcerated conditions. The organic diseases establish themselves much slower, while the malignant and so-called functional disturbances occupy a place between the two. The ptosis conditions usually cause

the establishment of subjective symptoms over longer periods, although there may be an acute onset due to a quick overthrow of the neurotic secretory and dynamic balance—particularly is this so in the post-puerperal cases. The cases of increased gastric secretion and atonic states usually give an irregularly running history, interspersed with sharp acute attacks. True sensory conditions of the severer types establish themselves quickly, while the secretory and motor are more subacute or chronic. Post-surgical gastric dilations are most acute.

Any state of illness which causes a loss of weight, physical strength, and vitality is always a serious condition. When this is distinctly due to organic change in the gastro-enteron and interference with the processes of digestion (and therefore assimilation and metabolism) and not to foolish low dieting, its importance is evident. In ulcers and functional disturbances loss of weight is not the rule. In well established chronic gastritis and in cancer, sarcoma, primary atonies, and intestinal toxemias it is.

Loss of appetite may be caused by any affection of the digestive tract, surfeit of foods, emotions, and disease elsewhere in the body. It is, however, a most constant symptom of stomach conditions, much more so than states of variable desire for food and drink and those of bulimia, polyphagia, and acoria in which the desire is abnormally increased and much of the normal satiety from eating may be lost. Clinically, the distinctions between bulimia, polyphagia and acoria are of little practical value. They all usually accompany functional neurotic, or organic diseases of the brain, or diseases or states of low metabolism; among such may be mentioned, hysteria, neurasthenia, epilepsy, hydrocephalus, cerebral tumors, Graves's disease, sexual affections, diabetes mellitus, etc. Bulimia is the permanent condition, polyphagia is paroxysmal, and acoria that in which a feeling of "emptiness" follows abundant feeding. The term pica is used for the craving of unusual or injurious substances, possibly of a repulsive nature (coprophagy). These usually accompany the insanities or idiocy, although less marked perversions may be seen in chloranemia, pregnancy, hysteria, and the capriciousness of childhood.

The appetite is generally lessened in cancer, atrophy of the stomach and in states of chronic gastritis; this is also true in amyloid degeneration, certain psychic and neurotic states both local and general, often in ptosis, and sometimes in myasthenia. In gastric ulcer the appetite remains unaffected, while in the height of and throughout the toxic and suppurating conditions and in the intense sensory disturbances and anorexia nervosa, it is lost. In the average clinical

run of chronic gastritis, primary atonies, and neurotic gastric conditions, it is usually variable, running all the way from complet anorexia and aversion to foods to acoria. Anorexia is present i epidemic influenza, pyrexia, chronic pulmonary tuberculosis, sup purations, debilitating and wasting disease, in early convalescence, i dyspeptics who practise self-prescribed abstinence, and in those wh are worried, stricken with grief, anxiety, or suspense.

Too much importance must not be attached to loss of appeti in gastric disease, and practically states of digestive function ca not be deducted from it. I have frequently seen a healthy app tite existing under conditions of marked digestive disorder, and aga found it much affected when no actual functional or organic disea was present. Thirst, however, is commonly present in states of d turbed motility, atony, and gastric neuroses, and is a more consta and reliable symptom. It is present in profuse watery discharg from the bowels from any cause, hemorrhage, toxic gastritis, diabet mellitus and insipidus, and in the dry mouth of xerostomia.

The condition of taste is of some value. The taste is often pappy insipid in chronic gastritis, bitter in jaundice and carcinoma, acid states of increased gastric secretion, and sweet in diabetes mellitu The condition of the mouth and nose has much to do with bad tas and breath. Among causative conditions may be mentioned cario teeth, periodontitis, tonsillar deposits, unclean condition of the tong coryza, polypus, ozena, etc. Purely subjective perversions of tas (parageusia) are usually indicative of hysteria, insanity, or the au of epilepsy.

Details of eating habits may give information which is of dia stic value. Excessive feeding for the physical and mental needs the individual means a tax on the digestive capacity and the ove loading of the intestines with toxins from which metabolic distur bances and their aftermaths might ensue. Overeating often accom pniies overindulgence in alcoholic drinks, coffee, tobacco, and so on, a these may develop atonic and catarrhal conditions. The character foods habitually taken and the manner in which they are cooked a served are of importance to note. Together with the number of me taken daily, is the time usually given to the eating of them. Has eating usually means insufficient chewing, and, with the low amou of saliva ingested (ptyalin), an added tax is put upon the digesti in the disintegrating of solid substances (like meat, fowl, and so on) and also the gastric conversion of starches is limited. These usua cause local neurotic, low forms of catarrhal, and atonic states, togeth

with the effects these have on intestinal digestion and the nutritional condition of the general body.

More or less pronounced states of dysphagia must be minutely analyzed. The common response "the food sticks in my throat and don't seem to go down," or when designating the low sternal region they say "it lodges and presses here after swallowing," are far short of subjective evidences of stenotic conditions in the gullet or cardia. The false condition of globus hystericus should always be ascertained by detailed cross-questions; the same may be said of esophageal and cardiospasms. The existence of the true stenotic conditions, when such stenoses are well established, can usually be learned from the history, remembering always that the fluid and semisolid foods are the most easily and quickly delivered into the stomach. Collective vomiting from the esophagus or a diverticulum is important. Many patients complain of difficulty in swallowing who have pharyngitis sicca or other faucial conditions.

Distress or pressure in the stomach after meals is the most constant symptom of gastric disturbance. These with pain and vomiting are the cardinal symptoms which bring most of the cases under observation. It is even more common than the two latter since it is present in the minor as well as the severe affections. In the mild forms of gastric disturbance the sensation is not as severe, constant, or long continued after eating as in the extreme forms. The cases in which it occurs quickly after ingestion are those in which the mere presence of foods in the organ is its exciting cause. Among these may be mentioned the true gastric neuroses in which the stomach is hypersensitive from neurotic or irritable states, and those in which the weight of foods or drink drags it down. Such would be found in the neurotic states of neurasthenia gastrica, mild types of gastralgia and hyperesthesia, and in the latter group, in simple gastric myasthenia, atonic ectasia, the lesser forms of true yet irregular types of neurotic motor disturbances, ptosis, etc. Those in which post-meal distress occurs later are apt to be due to the effects of the acid secretion on the organ, the presence of gastric mucus interfering with proper digestion, the functional breaking down of the normal digestive balance in the course of digestion, or those in which foods and the gastric secretion in the course of time become irritating to localized diseased surface. The sensation of distress may also be due to an increase above the amounts of normal fermentation, congestive swelling of the liver, or may be reflex from other diseases or conditions existent elsewhere in the body. Quite naturally, any true gastric case which gives a transitory history of pressure or distress after meals is more liable to

be a functional or catarrhal disturbance than one in which ulcer or cancer is present.

Actual pain in the epigastrium is a most reliable symptom and one of much importance. A clinical distinction between this and states of distress is of much moment. With pain, as with most subjective symptoms, the personal equation to distinguish the difference between it and only distress or pressure, and the matter of tolerance present wide varieties among people. But when actual pain exists, either during gastric digestion or when the stomach might be supposed to be empty, it usually means *bona fide* trouble, and close details on the history of it are of much value. Among gastric cases in which it is localized in the epigastrium may be mentioned ulcer, cancer, the intense sensory neuroses such as hyperesthesia and gastralgia, gastritis both acute and chronic, the orifice and stomach spasms, gastroparesis, etc. Among causes other than diseases of the stomach which may give local or more diffuse abdominal pain may be mentioned enteralgia, enteritis, lead colic, arsenical and mercurial poisoning, floating kidney (Dietl's crises), intestinal colic, obstruction, perforation, peritonitis, sudden hernia, rheumatism of the abdominal walls and lumbago, embolism of the superior mesenteric artery, abdominal neuralgia, acute pancreatitis, locomotor ataxia, and others.

It is important to obtain information as to the relationship of pain to the ingestion of foods, and to its site. When it is always present (whether the stomach is empty or full) in a cancer case, the growth is usually at the pylorus, and in the intense sharply localized types coming definitely and constantly a certain interval after eating (particularly coarse foods) it is strongly suspicious of ulcer in the stomach or duodenum. In gastric ulcer, it usually comes on within the first two hours, and in duodenal ulcer occasionally in the third and fourth after eating. Cases of even multiple ulcer may exist without pain (this should not be forgotten). In cases of increased secretion (hyperchlorhydria) the pain, or its forerunner, marked distress, comes on when the food is saturated with hydrochloric acid beyond its amount or chemical character—usually occurring one to three hours after eating. Also, a markedly acute pain coming on immediately after eating is present in gastralgia or acute gastritis. Those which come on at off times, independent of meals, are suspicious as due to locomotor ataxia, Dietl's crises, or gastroxynsis.

Marked acute seizures of belching of gas are strongly suspicious of neurotic disturbances or those due to simple dietetic indiscretions. Those conditions in which it is constantly present to a slight degree are found in chronic gastritis, cancer, the persistent neuroses and

atony. Eruptions, or gas accumulation in the stomach, coming on an hour or so after meals are commonly present in hyperchlorhydria and the hypersecretions. As to the taste of the gas, certain points are of value. An acid taste coming on one or two hours after meals suggests increased gastric secretion, and when this is at off times, a more or less continuous secretion of gastric juice. Bitter and foul tasting gases are often present in running history in states of gastritis, gastric stagnation and irregular fermentation and putrefaction; bile in the stomach will also cause it, although here it is of shorter duration in the case. Detail points are of value in this symptom of belching to separate the acute, neurotic, and mildly running chronic cases from the pronounced organic or malignant diseases. Such symptoms as "restlessness," "roaring in the stomach," and "all gone feeling" usually accompany the neurotic disturbances or catarrhal conditions.

Nausea occurs in a large number of gastric diseases and is a common symptom in chronic gastritis. It is commonly present in moderately advanced cancer in which, later on, vomiting is also added to it; here it may be independent of taking foods. It may exist in myasthenic and atonic states, in the neuroses to a less degree, and in tapeworm as long as the worm is present in large size. When it comes on quickly it represents acute gastric disturbance, and when continuing on an empty stomach, cancer, the gastric neuroses or other diseases of the body, such as anemia, menopause, the onset of the exanthemata, or fevers. It is rather a constant symptom upon which too much reliance cannot be placed unless it is present with vomiting.

Details regarding vomiting should never be omitted from the history. Note should be made when it takes place, for that which occurs rather constantly after eating usually means organic disease somewhere in the gastro-enteron. Simple regurgitation of food or fluid or rumination should be distinguished from true vomiting, since they belong, when vomiting is absent, to the less severe affections. Leaving out of consideration those diseases which are ushered in by vomiting or accompanied by it, it is a symptom of much importance in gastric cancer, ulcer, the benign stenosis, hour glass contraction, acute and sometimes chronic gastritis, gastrophtosis, occasionally in primary atony, in acute surgical dilatation, in gastro-chylorrhea, benign tumors, inflammations and adhesions of the stomach, intestines and abdomen, etc. It occurs as a constant symptom in gastric ulcer, usually coming on after the ingestion of food and in connection with the characteristic pains. In the insidious or chronic forms of

ulcer it may be absent. In late cancer and other causes of pyloric stenosis it manifests itself as collective vomiting; in the atonies, at the height of digestion from the disproportion between the dynamic power of the stomach and the quantity of gastric contents; in chronic gastritis, late in the meal, when the stomach is empty of foods, or only in the mornings; in high and continued secretions, when much gastric juice is present in the stomach without food; in acute gastritis, to empty the stomach of its offending contents; and in gastrophtosis, tumors, and adhesions for dynamic reasons. Added to these are the instances of vomiting from toxic products in the circulation, the reflex vomiting from the neurological system, as these may be produced directly, and the referred type from irritation existing elsewhere than in the stomach, but manifesting itself on that organ.

The vomiting of watery fluid or mucus usually indicates chronic gastritis, or that much mucus had been swallowed and subsequently ejected from an otherwise empty stomach. If the mucus is clear and of a sour smell its examination usually shows the presence of hydrochloric acid, and thus may be due to hypersecretion, other neurotic conditions, terminal vomiting of migraine, hysteria, movable kidney, and gastric ulcer. Bile-stained fluid is common in any acute case where constant vomiting is a feature. It may be seen in relaxed conditions of the pylorus and where perigastric adhesions interfere with the proper function of the pyloric muscle. It is a symptom of value in ileus or other states of intestinal obstruction, and peritonitis. In these conditions it often precedes fecal vomiting.

Hematemesis, of course, is a type of vomiting of supreme importance. When the blood is bright red it indicates recent hemorrhage, when it is in the form of clots or brownish-red in color it indicates a stay in the stomach of medium duration, and when it is dark brown (coffee ground) the blood has been more digested and changed by the gastric juice. In practice, it is seen in some quantity particularly in cases of ulcer, cancer, varicosities of the esophagus and stomach, and cirrhosis of the liver; and in streaks, in chronic gastritis, gastrectasia, chronic appendicitis and injuries to the epigastrium. Other conditions in which it is observed are rupture of an aneurism into the esophagus or stomach, swollen states of the spleen, the swallowed blood from the head or lungs, passive congestions due to heart disease or obstructive disease of the portal system, toxic gastritis, in the severe anemias (cholemia, leukemia), hemophilia, vicarious menstruation, Hodgkin's disease, scurvy, purpura hemorrhagica, typhus, yellow, malarial or relapsing fevers, malignant small-pox, and others. Care must be taken to distinguish true hematemesis from blood

delivered from the stomach which originally came from epistaxis, throat or mouth conditions, or that swallowed by malingers and hysterical persons. It must be remembered that red wines, preserves made from berries, etc., may give the appearance of red blood, and that coffee-ground vomit may be simulated in appearance by coffee, cocoa, bile and iron or bismuth preparations, all of which may give a brownish or blackish coloration to the stomach contents.

Fecal vomiting is indicative of intestinal obstruction, fistulus gastro-intestinal communication, or severe peritonitis. Pus is present in suppurative and infective gastritis, and rupture of an abscess into the stomach from nearby structures, such as subphrenic, hepatic, or pancreatic abscess. Segments of tenia, ascarides, oxyuris vermicularis, ankylostomum duodenale, trichinæ, fragments of echinococcus cysts, rupturing from the liver or spleen, are sometimes found in returns from the stomach, about which it may be said that they are all rare, and that tenia and ascaris are the more often seen.

Hiccough may be present in gastritis, gastrectasia, gastric cancer, neurotic conditions and in intestinal and other abdominal organ conditions. It is occasionally seen as a symptom in hysteria, shock and mental emotions, and in disease of the brain. In light forms it is of little consequence, but when it develops late in well established disease it is a symptom of grave prognostic importance.

Any distinct interference with the process of digestion either in the stomach or intestines may cause constipation or diarrhea; the first is by far the more common. In the neuroses of the sensory, psychic or mildly irritative types, the movements may remain normal. Constipation particularly is found present in the gastrectasias, supersecretion (hyperchlorhydria and gastrosuccorrhea), ptosis, esophageal and pyloric stenoses; in spastic, true obstructive or atonic states of the intestines, particularly the colon; for dietetic reasons, when abundant foods are partaken of which leave little residue (milk, eggs, meat); when too little fluids are taken, in heavy tea and red wine drinkers; where there is alteration, or diminution in the digestive fluids (fever, polyuria in diabetes, etc.); in abnormal conditions of the colon, rectum, anus, prostate, or uterus; and where constipation is found to be a constitutional trait.

Diarrhea, on the other hand, may ensue from constipation when the long presence of feces or that of other abnormal substances acts as an irritant to the mucosa, when increased irritability of the nervous system causes it to respond with unusual vigor to stimulation, and in a hyperemic, inflammatory, or ulcered condition of the mucosa cause increased secretion or transudation. It is seen in enteritis

## **ANAMNESIS.**

(- ulcers or ulcerative from whatever cause), in sudden attacks of hysteria; in intestinal crisis of movable kidney, exophthalmic goiter, uremia, intestinal cancer, the result of the ingestion of too abundant, indigestible or unassimilable foods; from sudden changes in temperature and the increased activity of micro-organisms produced by hot and humid weather; sometimes in appendicitis; and especially in profound exhaustion in tuberculosis, nephritis, cancer, pernicious anemia, etc.

The character of the stools are of much importance at the time should be learned if possible. The small caliber is found in cases of early cancer of the rectum, in prolapsus ani, occasionally as an early symptom, and in incomplete states of cicatricial stenosis of the anus. The constantly flattened, or ribbon-shaped consistency is observed in the same conditions as above, may be added the presence of any growth that may interfere with the roundness of its lumen when among such formations may be mentioned ischiorectal or large hemorrhoids, rectal polypi, and prolapse of the rectal wall. Rounded masses of hardened feces (scybala) are seen in habitual constipation, especially when this is due to relaxation of the colon from long-standing chronic gut toxemias. In states of high acid-enzymotic secretion of the stomach and gastro-enteric atony, and in the other conditions of constipation, to which may be added the use of opium, cathartics.

The color of the stool is also of value in the diagnostic way. A yellowish-green may be present in heavy milk drinkers when the bowels move rather freely and in saccharo-butyric toxemias. An unusually pale one is found when for any reason there is an absence or deficiency of bile poured into the intestine; in acute enteritis, typhoid; especially in constipation, in syphilitic or carcinomatous ulceration of the rectum (in which cases the bowel movements are often fluid from ulceration), and where substances rich in sulphur have been taken, such as many eggs, compound licorice powder, and sublimed sulphur (in these instances the ill-smelling stools are due to sulphuretted hydrogen). The formation of the color of the stools the matter of

In obtaining information of the color of the stools the matter of appearances which certain foods or medicants give to them should always be taken into consideration. Light yellow stools are common in excessive milk drinking, and deep red fruits and red wines may darken them considerably. Rhubarb gives a light brown color

to stools, and bismuth a bluish green or black. A constantly clay or light colored stool is usually significant of deficient bile secretion into the intestine. This condition is seen in gall-stones interfering with the flow of the bile, catarrhal states occluding the ductus communis choledochus, a tumor or displaced kidney pressing upon the common duct, or where there is deficient bile formation such as may be seen in anemia, chronic lead or phosphorus poisoning, gout, cancer, cirrhosis, amyloid disease or acute yellow atrophy of the liver. Green stools are seen where there is an activity of chromogenic bacteria in the intestine, when calomel had been given, or when, for any reason, there is an increased peristalsis hastening the exit of bowel contents before the cholechrome has the brown color seen normally in feces which had collected in the lower bowel (this so-called "biliary stool" is sometimes seen in acute enteritis and for the same sthenic reason in chronic diarrhea). Black stools are present in extreme constipation, and when iron, manganese or bismuth had been taken. The "tarry" or red stool is strongly suggestive of hemorrhage. In this, depending upon the source, the amount of bleeding and the length of time the blood is in the intestines, the color varies. When it comes from the stomach or small intestine it is black or brownish black in appearance from alteration by the action of the digestive fluids. Hemorrhage, nevertheless, may occur high in the digestive tract, and, when in considerable amounts and under conditions of increased peristalsis, be delivered from the body quite red. The general rule, however, is that such high bleeding causes dark stools in which the blood is incorporated with the feces. When the hemorrhage is from a low source (colon or rectum) it is bright red in color and present only on the surface of the dejecta, or may be passed without feces. When the bleeding occurs in the stomach or high in the small intestine and is slight in amount, the color of the stool will not be perceptibly changed (occult blood).

Tarry stools are usually indicative of ulcer or cancer in the stomach or small intestine, or ruptured varicose veins in the stomach or esophagus. Such ulcers may be the round acute gastric or duodenal ulcer (or both together), or the multiple ulcer of the small intestine of the typhoidal, dysenteric, or syphilitic types. Other conditions in which such stools are seen are when blood had been swallowed from the lungs or nose, in thrombosis or aneurism of the aorta or superior mesenteric artery, engorgement of the portal circulation due to cancer, cirrhosis of the liver, portal thrombosis, valvular disease of the heart, emphysema of the lungs, in jaundice from any cause, in infectious disease, and in blood conditions such as hemophilia, pur-

pura hemorrhagica, scurvy and leukemia. Again, it may be caused by tubercular ulcerations in the intestines due to phthisis, as a result of injuries to the abdomen, and finally the presence of intestinal parasites may cause it.

Bloody stools, on the other hand, may be caused by any of the above conditions when blood is delivered unaltered into the lower bowel; from hemorrhoids, cancer, ulcer and polypus of the lower bowel, fissures of the anus, amyloid disease of the intestine, acute sigmoiditis and colitis, the sudden diarrheas of exophthalmic goitre, and, in children and infants, intussusception.

Most of the intelligent and observing patients will readily answer the question or will voluntarily supply the information as to the presence of increased amounts of mucus that had been passed with the feces, or that they have had passages consisting mostly of fluid mucus. When mucus is voided in plainly macroscopic amounts it is pathological and indicative of some catarrhal process in the intestine. Where it occurs as a thick coating upon the feces, or if mostly mucus is passed with little or no feces, it designates an inflammation of the large intestine or rectum. When it is incorporated with the feces, the catarrhal process is usually in the small intestine. In the first instance, mucus is often passed in dense looking shreds resembling long folded strips of loose, white fibrous tissue, although closer examination or questioning will often disclose the additional voiding of the more fluid gelatinous mucus, resembling egg-white. In the ignorant or less observing patients, the passing of mucus may not be noticed until their attention has been drawn to it. Conditions in which quantities of mucus are passed rather chronically are the various combinations of abdominal ptosis, in colitis, sigmoiditis, and proctitis. In enteritis, enterocolitis, and dysentery, the mucus is of the incorporated variety and may not be recognizable to the naked eye. True membranous shreds (not mucus) may be observed in necrosis and sloughing of the intestinal mucous membrane, which condition may occur in cancer of the lower bowel and rectum, ulcerated and intense inflammations of the colon, sigmoid, or rectum, and relapsing fever. An oily, greasy-looking, fatty stool may be noted in obstructive jaundice or where deficiency exists or no bile is being secreted. In these instances, the feces is whitish, gray, or light yellow in appearance. The darker stools of fatty diarrhea are suggestive of cancer of the pancreas, or impacted calculi in the pancreatic duct.

Among other objects that may be observed in the stool are intestinal parasites or segments from them; such as the round or pin

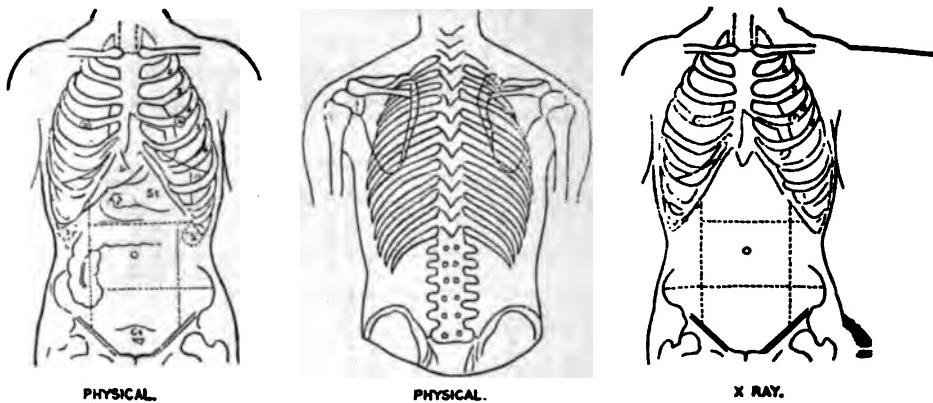
worms, and the varieties of tenia. Gall-stones, enteroliths, polypi, and a sloughed segment of the bowel in intussusception may also be seen.

#### HISTORY RECORDS.

The advantages of keeping records of the cases examined, the treatment prescribed and results from same, are of inestimable value, and the busier the physician in the clinical way the more necessary it is that such details as may pertain to a case be noted in writing and not trusted to memory alone. Such records are not only of value for medical literary purposes, but, by preserving records of cases that had been treated successfully in the past, valuable information from personal observations in the trite notes on the case are, in the history box, of much steady service as records for a wider scope of service in any new case that comes to hand. Added to this is the advantage of being able to quickly obtain from the files the record of a case treated years ago and which person again comes under observation, and the comparing of the present history with that of the past.

It is surprising how little more time it takes to make records of cases when one habituates himself to it in steady practice. As the individual relates his history before you, as he responds to the questions that you ask, a pen or pencil noting terms in abbreviation can follow a history along with but trivial expense of time, and a record may be compiled which would be of much future value. Of course, here a stenographer is of much help.

For the purpose of recording this, and referring to it quickly, the use of history cards is the handiest. These may be kept in a box upon the office desk, in which the cards are kept in alphabetical order according to the names of patients. The same may be said of cases seen in the hospital or sanitaria. In dispensary clinics, however, it has been my observation that when many cases are being handled, it is best to keep such cards in numerical order according to the number on the dispensary cards rather than according to the names of the individuals. My reasons for this are that it is quicker to note the number on the clinic card and find the proper card in the file, than to ask, get the response, and then sometimes have to analyze the name, particularly when it is a peculiar one, or it is poorly pronounced. Added to this, is the disadvantage in finding the card among a great number of others, all kept together in the divisions under the one letter.



Reverse side of author's examination blank, for observation  
notes and treatment.

The folder also answers to file notes, laboratory or letters from ~~or~~ patients, etc., by simply inclosing them in the folded sheet.

Fig. 11.—Separate Laboratory 'Slip which Fits in the Folder.

ILLUSTRATIONAL TEST-MEAL

FRACTIONAL TEST-MEAL	BLOOD CHEMISTRY						REMARKS	
	Urea N.	12-15 Mg. .09-.12 P. C.	Mg. 50-75 C. C.	Mg. 1-2	Mg. 2-3	Mg. 25-30		
140	-	-	-	-	-	-	-	
130	-	-	-	-	-	-	-	
120	-	-	-	-	-	-	-	
110	-	-	-	-	-	-	-	
100	-	-	-	-	-	-	-	
90	-	-	-	-	-	-	-	
80	-	-	-	-	-	-	-	
70	-	-	-	-	-	-	-	
60	-	-	-	-	-	-	-	
50	-	-	-	-	-	-	-	
40	-	-	-	-	-	-	-	
30	-	-	-	-	-	-	-	
20	-	-	-	-	-	-	-	
10	-	-	-	-	-	-	-	
0	-	-	-	-	-	-	-	
Titratable Acidity	1.4	1.2	3.4	1	1.4	1.2	1.3-4	
Blood Urea	-	-	-	-	-	-	-	
Bilirubin	-	-	-	-	-	-	-	
Mitens	-	-	-	-	-	-	-	
Lact. Ac.	-	-	-	-	-	-	-	
L. A. Bae.	-	-	-	-	-	-	-	
Residue	-	-	-	-	-	-	-	
Culture	Wassermann						Fixation	
Blood	Wassermann						Fixation	

## CHAPTER V.

### Examination of Patients.

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#### INSPECTION.

In a broad way, inspection of the body takes into consideration every external symptom any way connected with the diagnosis of internal diseases. While a practical knowledge of the cutaneous diagnostic details is of much value in connection with internal medicine, and often has most important bearing upon the abdominal conditions, in this work the author will consider only those pertaining to the oral cavity, the abdomen as a whole, and the stomach in particular, although, of course, all others are important.

Among the essentials necessary for the inspection of a patient are a good light and a horizontal plane for the patient to lie upon, and in the selection of these, a few remarks may be made. After a rather close attention to the matter of light I have come to the conclusion that daylight has certain advantages and that artificial light thrown directly upon the patient has others, although of the two, in a general way, daylight is to be preferred. The advantages of daylight are in the more perfect estimation of such details as color of the mucous membrane and skin and the better general illumination of the patient; and those of artificial light, in obtaining details in shadow effects and the concentration of a flood light upon a certain part of the abdomen while all about is dark. While these are matters of minor importance in a general way, for fine work in physical diagnosis they may be very valuable in some cases. The best plan is to have an examining table near the window of a room so that the direct sunlight does not fall upon the patient, and another in a dark room above which table is a hooded chandelier throwing its light directly upon the trunk of the patient and a hooded portable light nearby capable of throwing a light, horizontal, transverse or vertical to the abdomen. By this arrangement of artificial lights, often fine movements of the hollow viscera or slight eminences in the abdomen, which might escape observation in the daylight, are brought into more prominent relief.

In the selection of a table, I much prefer one solidly built of strong wood and made to order by a carpenter, to any table or exam-

ining chair I know of sold extensively for the purpose. The table I now use and which gives complete satisfaction for office work is built of dark stained oak and has the following dimensions. The top of the table is 6 feet long and 28 inches wide, and this is supported by four strong posts 30 inches above the floor. The top of this table has a thin mattress covered with black oilcloth, on which is placed a thick head cushion to make the patient comfortable while lying upon it. Such a table, also, answers admirably for use in mechanical or electrical treatments of the abdomen. In hospital work it is best, when patients are well enough, to have the person placed upon the wheeled carriage used for transporting patients, and have him taken into a well-lighted room rather than examine him in the



Fig. 12.—Examining table used by the author.

bed. The bed is usually too low, and the foot end is in the way. On the wheeled carriage you can readily pass from side to side and turn the patient as may be desired according to the play of the light.

The examination of the mouth may suggest information of direct cause or predisposition to disease of the stomach. A pale color of the lips is often significant of anemia, and a slight blueness beginning cyanosis from cardiac disease. A trembling of the lips may be due to extreme nervousness, and a convulsive raising of the upper lip or a drawing down of the angles of the mouth that of severe abdominal pain. Herpes labialis is especially common in malaria, pneumonia, febrile disease, and acute coryza. Rhagades or the scars from them are suggestive of syphilis. Pricking and tingling sensations in the lips are suggestive of neurotic states of the general body.

The odor of the breath may be of considerable value in diagnosis. A common cause of bad breath is some form of chronic gastritis, an intestinal toxemia of the putrefactive type in which excessive sulphates are

being resorbed, or habitual constipation. Local conditions in the mouth may be the cause of a most foul odor to the breath; among such are caries of teeth, glossitis, lacunar concretions in the tonsils, suppurative and necrotic conditions of the jaw or gums, and the severe diseases of the lungs. A urinous odor is not uncommon in uremia, and a sweetish odor of beer or apples in diabetes mellitus.

The secretion of the saliva may be checked in disturbances of the salivary glands, gastric neuroses, fright, febrile states, chronic gastritis, nephritis, and diabetes, particularly when polyuria is present. On the other hand, excessive secretion of saliva is seen in irritated conditions in the mouth, in the psychic neuroses and hysteria.

The gums show a characteristic paleness in anemia, and a blue-gray line at the margin in chronic lead poisoning. The entire extent of the gums may be reddened in scurvy, and swollen and sore in constitutional disease, mercury poisoning, or in gastro-enteric affections. In my opinion, when local causes can be excluded, the condition of the gums is a valuable barometer of general states of the body.

The examination of the teeth should always be made. Note should be taken of their general condition, the number and alignment of the molars so that thorough chewing of foods is possible, and that artificial teeth, and the plates supporting such, set snugly and are not irritating to the gums or palate. If a soreness exists in the mouth, because of artificial teeth not fitting properly, patients are liable (because of the pain) not to chew their foods sufficiently. Persons who neglect the care of their teeth have much tartar upon them with marginal ulcerations of the gums, usually have increased amounts of micro-organisms in the mouth, and these being swallowed could cause irritative conditions of the stomach.

Riggs's disease should be searched for because irritative stomach conditions are produced by this condition. If there is suggestion or possibility of neglected or poor root canal work an X-ray examination of the teeth may be necessary.

A close examination of the tongue may be of some service, although in diagnosing digestive diseases or differentiating between them, much reliance should not be placed upon the findings. Müller and Fuchs, have found (and my own observations somewhat coincide with theirs) that 62 per cent. of all healthy individuals in youth and middle life presented a coated tongue. There is no doubt that in the past too much reliance had been placed upon the condition of the tongue as being indicative of digestive diseases. It should never be forgotten that because of the position, function of the tongue, and the commonness of pathological conditions elsewhere in the mouth

and throat, the tongue is most liable to change from the normal even when the digestive tract and general state of body be normal. Leaving out of consideration such local conditions and habits (smoking, alcohol drinking, etc., as may affect it locally, of some practical value are the following: The tongue is pallid in anemia, may be bluish in cyanosis from cardiac disease, have pigmented spots in Addison's disease, or be tinted yellow in jaundice. It is usually very tremulous in chronic alcoholism and in insanities, and ulcerated in syphilis and the exanthemata. It is distinctly dry (typhoid tongue) in states of general adynamia, toxic states and prostration, may be swollen in septic conditions, and shrunken in old age (senile glossal atrophy) or a result of paralysis. A thin white coating is common in excessive micturition and many cases of long standing mild degree of simple chronic gastritis. A rather flabby, pasty looking tongue showing marginal indentations from the teeth is the rule, in long standing cases of chronic gastritis having much mucous secretion, and in subacute gastroduodenitis.

The soft palate, the tonsils, and pharynx should always be examined. My experience has been that "dry throat" is a common complaint in true gastric conditions. More or less pharyngitis commonly seen in cases of digestive disturbance, but I have yet seen a *bona fide* case of gastric disturbance—even of the neurotic type entirely relieved by the cure of some throat condition alone. I believe, however, that rather steady belching of gases, or the regurgitation of small amounts of foods from the stomach, often does cause a pharyngeal catarrh which gives local symptoms of distress. But that any evident gastric case is ever developed from a pharyngitis, as is stated above, is cured by simply the treatment of same, I have my serious doubts. Excluding the nasal and tonsillar cases of secondary pharyngeal involvement and those possibly of a primary nature, a pharyngitis in a distinct gastric case should always be looked upon as a primary condition or as a symptomatic result of the stomach disturbance. Laryngologists cannot cure a "gastric catarrh" by curing a pharyngitis.

Inspection of the abdomen may give no details of diagnostic value, and in other cases again most useful information may be gained. As a routine, it should always be performed in the beginning of every physical examination, and notes should be made of the appearance of the cutaneous surface, nutrition of the walls, shape, size, bulging (when present whether local or general), excursion or retraction of the abdomen as a whole during respiration, and also whether peristaltic movements of the gastro-enteron are visible.

The appearance of the skin of the abdomen in this connection is of value in the following ways: Linear albicantes are found following pregnancy or marked reduction in weight, both of which conditions may predispose to ptozed states of the abdominal organs. A line of pigment in the median line (particularly below the umbilicus) is indicative of pregnancy, a condition in which gastric distress and vomiting are common. Spots of eruption of the cutaneous diseases, and the rose spots of early typhoid may be seen. Some knowledge of the gross appearances of the common forms of skin diseases is of value, particularly in being able to differentiate the irritative rashes due to toxic absorption from the colon and the excretion of these poisons by way of the skin, from the more chronic types of skin disorders. The yellow tint of jaundice or leukemia, or the fainter yellow of toxemic jaundice, the very light, yellowish brown of malignant cachexia, and the faint brown of hepatic cirrhosis may be observed. A general brown or brownish-black color is seen in Addison's disease, although here the pigmentation may be very faint and only present on the upper extremities.

General enlargement of the superficial abdominal veins may be seen in greatly dilated stomachs, cirrhosis or tumor of the liver, and obstructions of the vena cava. The so-called caput medusæ may be seen in obstruction of the portal circulation or hepatic cirrhosis. Note should be made of absent or limited abdominal respiratory movement (peritonitis), and excessive abdominal breathing (diseases of the lungs).

To note the nutrition of the wall is of much value in diagnosing gastro-intestinal cases. In malignant disease the subcutaneous fat of the abdomen is more or less lost. Likewise is this true in atrophic states of the glandularis of the gastro-enteron, marked gastro-enteric atony, and in the chronic constitutional affections. The skin will then be loose and wrinkled and may even sag at the flanks or gluteal region. In the neurotic, acute and most of the chronic catarrhal conditions this will not be observed.

The shape, size, and bulging of the abdomen often give important diagnostic suggestions. An abdomen that is large in size, pendulous in the upright position and which flattens in the recumbent position, means relaxed abdominal walls (a common result following pregnancies), and is often seen in the case of more or less splanchnoptosis and chronic colitis. Note should be made of the shape and breadth of the body, for the long thorax-abdomen type of individual often has a gastrophtosis; the same may be said of those individuals who have widely flaring ilia and a wide costal arch. Under favorable

conditions in thin-walled subjects, the outline of the stomach or colon may be seen, but only when these are much distended with gas. In such relaxed and thin-walled subjects the stomach may perceptibly raise the gastric region, or more or less coils of the small intestine may cause a general irregularity of the surface. Furthermore, the abdominal wall may be raised and present a local bulging from the mass of a neoplasm connected with any of the more deeply seated abdominal organs, even the kidneys.

The opportunity is frequently offered to observe the peristaltic waves of the stomach and the vermicular movements of the intestines. They present themselves as a series of rolling, rounding elevations, which increase and subside. In the stomach they usually run from left to right (antiperistaltic stomach waves from stenosis run from right to left but are never as prominent as the foregoing), and in the colon they pass from right to left. This may serve to distinguish in which organ they are seen, although those of the stomach are always sharply confined to the gastric region, while those of the small intestine and colon are more general in the abdomen. They can often be made more active by stimulation applied to the abdomen. For this purpose my preference is in sharply flicking the skin with the finger, although ether spraying, faradism, or striking with a cold wet towel may be employed. While visible peristalsis may occur in a case not stenotic in type, its principal diagnostic association is in connection with pyloric or intestinal stenosis and in the instances of the so-called peristaltic restlessness of Kussmaul, which is a rare neurotic disturbance of motility with or without subjective symptoms. In cases of obstruction it is a most valuable symptom, and in the benign conditions where the constitutional signs of malignancy are absent (cicatricial contraction, perigastric and perienteric adhesions, the pressure of other organs or growths from them upon the digestive canal, etc.), they are a sheet-anchor diagnostic point. At times some practical inference may be drawn as to the site of the obstruction by the location of these movements and the behavior of bulging under pressure. If the obstruction is in the region of the ileocecal valve, the coils of the small intestine may lie one above the other in the center of the abdomen. If the stenosis is in the lower colon or high in the rectum, the distention is around the confined limits of the abdomen corresponding to the location of the colon. Should the distention and peristaltic movements be confined to the upper and left quadrant and running toward the pylorus the stenosis is at that region. Should a large globular distention exist which on pressure subsides with a gurgle of gas, and after which this distention recurs, and one has

repeatedly the same experience with it, the stenosis is just below the dilated portion of the intestine pressed upon.

### PALPATION OF THE STOMACH AND ABDOMEN.

The art of successful palpation is a very important one for every physician to acquire, and points of technique in doing this successfully are of much value. As the finger in a wound is the best kind of a probe—because the mind is directly connected with it—therefore one should think while palpating, rather than do this in an aimless search for some surprise.

With the patient in the dorsal position and the entire abdomen

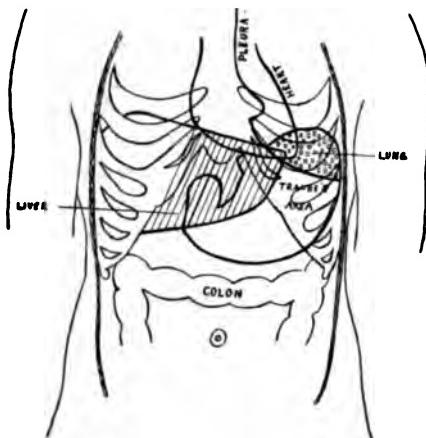


Fig. 13.—Showing the relation and coverings of the stomach in front to the liver, heart, left lung, pleura and left thorax.

from the thorax to the symphysis pubis exposed, the warm hand is laid gently and flatly upon the abdomen, where it is permitted to remain for some moments until the patient is accustomed to its presence. The palpation is made with a circular pressing movement, sliding smoothly over the skin from one part of the abdomen to another. A steady gentle pressure is much to be preferred to any sudden poking movements. In the course of time, a rather firm pressure with the palmar surface of the tips of the fingers is made to feel deep into the abdomen. The examination may be conducted with the knees raised and separated and the shoulders elevated so as to relax the abdominal muscles, advice being given to breathe deeply and slowly; a detracting conversation often keeps the attention of a neurotic, apprehensive, or hysterical patient away from what is taking

place and further favors relaxation of the muscles. During the examination, the physician's attention should be directed to the face of the patient, making note of the facial expression as certain areas of the abdomen are pressed upon. If sufficient abdominal relaxation cannot be obtained, examination in a prolonged hot bath or under anesthetic may be advisable.

The alimentary canal should be empty at the time of the examination, although the first visit may be taken advantage of for noting the presence of plainly evident physical signs, and also the presence of scybalous masses in the colon (constipation). If much gas is present in the stomach, it may be necessary to remove this by means of a stomach-tube, or if the intestines are likewisely distended by irrigation or purgation. In a few instances the examination may be made on a stomach distended with food (peristaltic and vermicular movements, peristaltic restlessness and gastric stiffening). If it is desirable to press deeply into the abdomen one hand may be placed upon the other, and at each expiration the under hand is sunken, maintaining this position until the next expiration, when it is sunk deeper, and so on until further pressure is inadvisable. Since patients may evince a sense of pain when the nails of the examining fingers are dug into the skin, it is best to keep them trimmed closely so that the tactile pulp of the fingers projects beyond the nail edges. At the start of the examination it is wise to dance the finger tips over the abdomen beginning at the upper recti muscles, then down to the pelvis, finally at the sides, not neglecting the flanks. The object of this is to note spasm or stiffness of the muscles, for often indeed a valuable suggestion of renal disorder having peritoneal irritation is secured.

The various areas of the abdomen should be systematically explored beginning first with the location of the stomach, then the small intestine, the ileocecal valve, all of the colon and finishing with the marginal or deep organs, such as the liver, gall-bladder, spleen, kidneys, etc. In examining the lateral portions of the abdomen both hands may be employed, the under one sustaining the lumbar region while the upper makes pressure upon it to note the character and consistency of the intervening tissues. To finish the palpation, it is wise to turn your back to the patient's face (leaning over his thorax), rest your one elbow at the side of the abdomen, and, with the ulnar surface of both hands at the lower limits of the abdomen, palpate upward with the ulnar surfaces of the hands and tips of the fingers to under the costal arch. I recommend doing this with eyes closed, keeping your mind on the abdomen.

It is often advisable to change the position of the body from the dorsal, and it is always essential to also examine prolapsed organs in the upright position so as to note their degree of descent. In the Deihō method of noting the position of the greater curvature the latter position is required so that the water sinks to the lowest portion of the organ. The spleen (when not much enlarged), and movable kidneys (when not very loose), and the gall-bladder may become palpable in the slightly forward sitting or the knee-chest position when they are not so in the dorsal. This position is also necessary to observe the true shape of the abdomen when standing (Landau's ptosis). A method of palpating for a movable kidney which I have found of much service (in fact I think it to be the best method) is, while the patient is sitting, to grasp during deep inspiration the side wall of the abdomen between the thumb in front close under the ribs, and the other four fingers of the same hand on the lumbar region. Maintaining this hold firmly, when the patient has taken a long breath, the person is slowly put in the dorsal position while the other hand, pressing deeply upon the abdomen below the thumb, delivers under it the intervening structures, the patient at this time exhaling. Often in this way, a movable kidney will be felt to slip upward with a jerk, while at the same time the patient experiences the unpleasant sensation of when a kidney is directly pressed upon. In patients who have large, fat abdomens it may be desirable to have them turn partly to the side (so as to displace as much of the abdomen and intestines as possible) while palpation is carried on in the upturned side. The lateral position is also to be preferred to the dorsal in palpating the spleen or growths at the fundus.

A method to be recommended in all abdominal tumors is bimanual palpation. In this, with one hand on each side of the mass, better note can be made of its size, shape, surface, and movability; particularly is this valuable with small sized movable growths of the pylorus, pedunculated growths, and freely movable kidneys.

Palpation of the abdomen in women should always include the pelvic region, and a vaginal examination when organic disease or growths in the internal generative organs are suspected. Also, it is essential in both men and women when the least suspicion of rectal disease exists to examine the anus, rectum, and possibly the sigmoid.

It is now important to consider in some detail, findings which are away from the normal. The diagnostic points between cancer and false tumors; those of involvement of the different abdominal organs will be found in a subsequent chapter.

**Pains, Direct and Reflex, and Pressure Distress.**—The most common symptoms obtained by palpation are hypersensitiveness or pain on pressure, and these comprise most valuable factors in the diagnosis of gastric conditions. Before beginning a consideration of these, it would be well to state that deep pressure upon the epigastrium in perfectly normal individuals is often accompanied with a feeling of distress and sometimes nausea. On the other hand, normal persons are seen in whom this does not exist, and I have observed the same to be true in a number of the gastric neuroses cases when these are only psychic in origin or of a secondary nature. It is logical to assume that any sensitiveness to rather light pressure—which when further continued causes actual pain, not simply nausea—is caused by some local condition in the stomach or in the organs immediately about, and it might further be said that most persons who come under observation distinctly as digestive cases, in whom some degree of discomfort is not caused by deep pressure below the ensiform, are either a gastric neurosis or the cause of the gastric symptoms must be searched for elsewhere. Again, it must be added that sensitiveness to pressure in the epigastrium might be caused by disease of the left lobe of the liver, colon, and pancreas, as well as by true stomach conditions. So, too, a sensitiveness over what may be considered as the greater curvature of the stomach may be due to disease of the small intestine or omentum. Of much confirmatory value that the pressure on a certain area of the abdomen is causing actual pain, or that a *bona fide* organic disorder of the viscera below exists, is a constantly present resistance of a section of the abdominal wall in that area, while in other regions the wall remains lax when pressed upon; such is often seen in conditions of the pylorus, gall-bladder, and appendix.

Tenderness, more or less general, is common in acute gastritis and somewhat less so in the chronic form. It is found in some of the sensory neuroses, in diffuse gastric cancer, in gastrophtosis, and in gastric ulcer. In the catarrhal conditions it is usually diffuse over the gastric region, and, excepting in the very acute conditions, is not accompanied with much if any resistance. In the local neurotic and gastroptotic cases the tenderness is usually confined to an area just below the ensiform about the size of the palm of the hand, and as a rule is not accompanied with resistance. The front pains of gastric and duodenal ulcer when present, are sharply localized, situated just below the ensiform to the right or left of the median line, and generally are accompanied by a quickly responding and stern resistance; the same may be said of unfavorable post-ulcer conditions, although in these (because of less pain) the resistance is liable to be not so prominent a feature

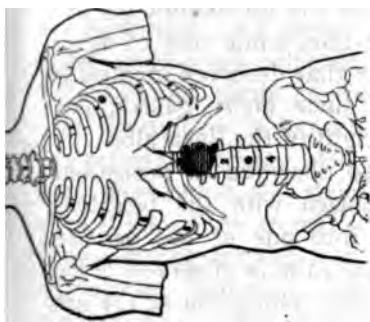


FIG. 1.

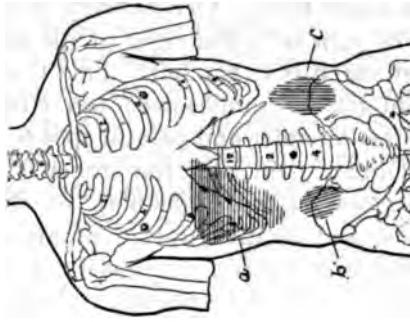


FIG. 3.

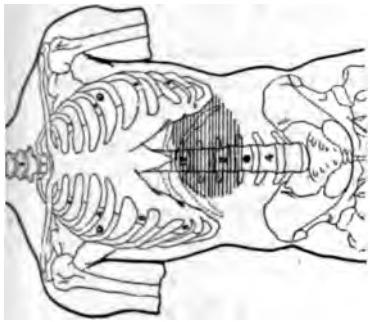


FIG. 2.

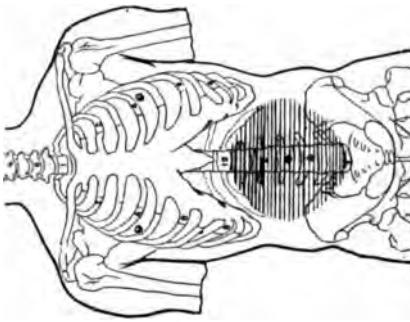


FIG. 5.

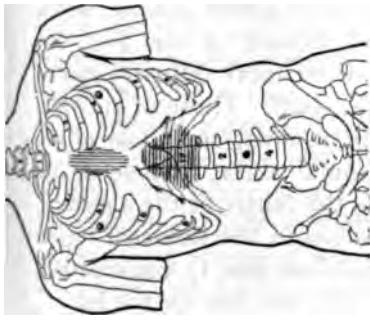


FIG. 4.

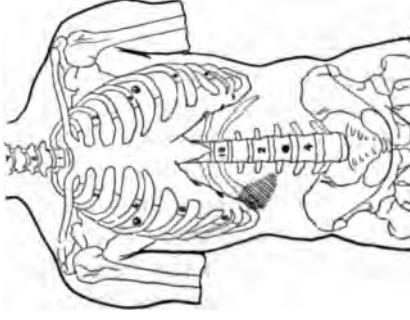


FIG. 6.

**FIG. 14.—Front areas of pain or tenderness.**

**FIG. 1.**—Painful and tender areas on pressure in neuroses, gastritis and gastrectomia.

**FIG. 2.**—Area in which are usually found the pains or distress on pressure in gastritis, erosions, impacted gastric colon and the pains of carcinoma, ventriculi.

**FIG. 3.**—Sharply localized pain area of gastric and duodenal ulcer.

**FIG. 4.**—Area of pain in cholelithiasis, gall-bladder disease and disease of the bile ducts.

**FIG. 5.**—Area in which are found the pains of enteritis, enterocolitis, intussusception, intestinal obstruction, peritonitis, embolism of the mesenteric artery, floating kidney, aneurysm of abdominal aorta and disease of the pancreas.

**FIG. 6.**—Pain locations in disease of the liver and impacted hepatic colon: at *a*, appendicitis; at *b*, renal colic (either side), mucous colic (usually left); at *c*, constipation, stercolar ulcer and sigmoiditis, etc.

as in acute ulcer. Occasionally in ulcer of the duodenum the small area of pain is to the right of the median line, while that of ulcer of the stomach is to the left. This is a point that deserves mention but should not be emphasized too strongly since many gastric ulcer manifest a tender and painful spot to the right of the linea alba.

Diffuse pain over the stomach is also observed in perigastritis, in perforation with adhesions of the stomach with the neighboring organs, and finally rupture of an ulcer into one of the peritoneal cavities, particularly the lesser. Localized pain is observed in trau-matism, localized peritonitis and perigastritis, phlegmon of the stomach, disturbed conditions of the celiac or solar plexus of the sympathetic and the celiac axis. Multiple spots of tenderness of a flitting nature over the stomach and elsewhere in the abdomen are strongly suspicious of a nervous dyspepsia or neurasthenia.

In the matter of different locations in the abdomen on which pressure elicits pain, the following may be included: Those of gall-bladder or gall-duct disease are manifested rather locally over these structures. An inverted elongated triangle with its base corresponding to the costal margin the center at the tip of the ninth costal cartilage and the apex at the navel would include them. It must be remembered, however, that deep palpation over the ducts would also closely include pressure upon the pylorus and the pyloric region of the stomach, the duodenum, the transverse colon at that point, and head of the pancreas. The symptoms and the clinical course of the case together with the rather distinctive back pains of gall-bladder disease would help to differentiate them. The pains of disease of the liver, obstructed portal circulation and hepatic colon are more diffusely spread over a larger area corresponding to the liver itself. Those of enteritis, enteralgia, colics, intestinal obstruction, peritonitis, embolism of the mesenteric artery, aneurism of the abdominal aorta, disease of the pancreas, and floating kidney are usually in the center of the abdomen. In appendicitis and those due to inflammation in the ileocecal region the pains are low on the right side; while those due to constipation, stercoral ulcer, sigmoiditis, mucous colic, etc., are low on the left.

Tumors in the Epigastrium, etc.—In examining new growths of the stomach it should be remembered that many different forms of tumors are met with but that in elderly persons most of these are cancerous formations either at the pylorus or lesser curvature (combined about 78 per cent.). These are usually felt as situated in the median line between the ensiform and the umbilicus. The growths may be quite movable and capable of displacement, or if adhesions to fixed organs or tissues are present it is firmly moored. If these

adhesions are with the liver (one-fourth of all cases), or with the diaphragm, the growth may move with respiration. A deep-seated, small-sized palpable mass may be felt in cases of chronic gastric ulcer and *ulcus carcinomatosum*, and, under favorable conditions, the pylorus in hypertrophic gastritis and the diffuse thickening of a perigastritis may also be noted. The palpation of a tumor depends more upon the rigidity and thickness of the abdominal wall, the position of the stomach, and the position of the tumor in relation to neighboring organs than it does upon the size of the tumor. On this account, tumors are more readily palpable in women, in whom the abdominal organs are more frequently ptose and the belly wall relaxed than in men. A table of differentiation between true and false gastric tumors will be found in Chapter XXI.

If the abdominal walls be thin and relaxed and the stomach empty, it may be possible to feel growths of the pancreas, and, as Ewald has shown, even the normal gland and lymphatic glands in the gastrocolic ligament. In cases of cholelithiasis a mass corresponding to the site of the gall-bladder, moving with respiration, is not uncommonly palpated; this is best noted with the patient sitting and resting upon your shoulder, you sitting behind with both hands under the costal arch on each side, pressing inward and upward. New growths connected with organs elsewhere in the abdomen may be felt in other localities than the upper zones. Among those in this connection should be mentioned floating kidney and fecal tumors, both of which may be found above or in the transverse umbilical line. Unless bound down by adhesions, displaced kidneys are freely mobile, and masses due to the presence of scybala are migratory along the colon and are usually moved onward by a brisk cathartic, a practice always to be advised when any doubt exists as to the character of a mass felt anywhere in the abdomen. Lastly, it should be mentioned that results from palpation in the way of noting the contracting power of the abdominal walls and the voluntary control over them are very valuable in diagnosing relaxed and atonic states of the muscle walls; often observed deficient in ptose states of the organs within.

According to Head, stimulation is excited from diseased states of internal organs, and, being transmitted by way of the sympathetics to a distinct spinal segment, are referred to sensory fibers of the skin which pass backward into the same segment. This means the existence of hyperalgesic areas on the body reflexly caused by disease of organs within, and, according to the localities in the skin in which these areas are observed, inference of diagnostic worth might be made as to which of the internal organs are affected. After a rather close

#### THE HEAD ZONES OF PATIENTS.

These so-called Head zones in abdomen and thorax were found to have been properly localized, but little dependence can be placed upon them, as they may be found in disease of the viscera, and vice versa. No conclusions, therefore, can be drawn from them. In my experience errors in diagnosis are frequent, and apparently present they are liable to be misinterpreted as corresponding to the organs involved. The best method of diagnosis is to determine the visceral lesions by means of the situation of the zones, which can then be considered in connection with other symptoms. This may have some value, but this is very difficult, as it is impossible to accurately distinguish other areas of tenderness or sensitive areas and thus lead to the error of diagnosis. It is well known that disease exists; such as where the spots are located in the head, neuralgia and central neurological affections, etc. The physician must exercise the greatest care, experience and patience in making these observations, and, more particularly, the physician must be of the intelligent kind, and be willing to take time with a desirable patient for the examination, as the result of a single rubbing or scratching of the skin with a dull instrument shows an apparently positive result at one moment, which may be confirmed as present in the next. My experience has shown that the pyloric and gall-bladder zones are more often present than others, but that much attention in the diagnostic process should be attached to their absence.

There are also other areas which are painful areas to point-pressure on the back, particularly in the thorax. Most of the conditions giving such indirect signs are shown in the following illustration (Fig. 15). Some of these areas are increased or intensified by pressure upon the skin, and are called tender; others again are first found existing during the course of disease and are markedly increased on pressure.

The most common gastric conditions particularly in which pressure-points or tender areas are found are gastric ulcer and the neuroses. In gastric ulcer, the area of pain has been shown, in about one-third of the cases, pressure-points located to the left of the spine close to the body of the twelfth dorsal vertebra. In my experience, the tender area found in cases of ulcer is located higher than this, and from the eighth dorsal to the first lumbar may be considered as the limits in which this back pain is located. When present, it is noted as a very tender area close to the spinous process and is most exquisitely painful to deep point-pressure. On the other hand, cases are seen where the characteristic tender area is located to the right of the spine, and these are more suggestive of the ulcer.

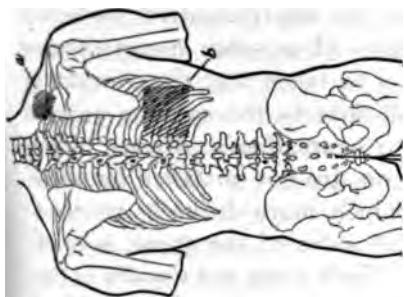


Fig. 1

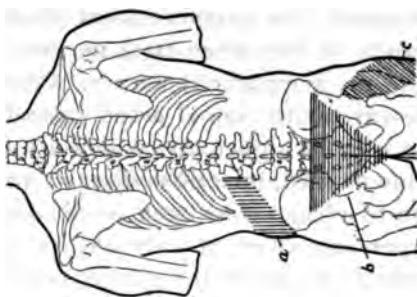


Fig. 2

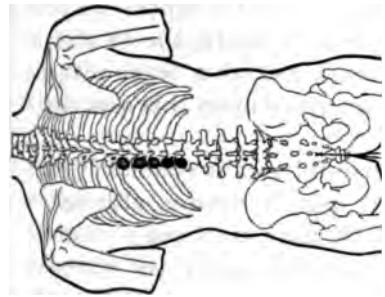


Fig. 3

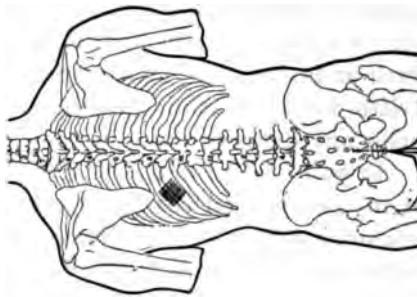


Fig. 4

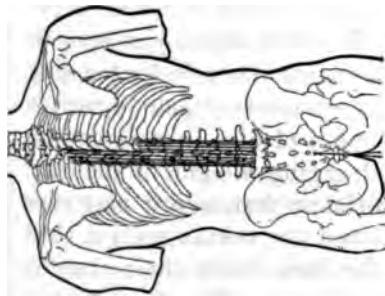


Fig. 5

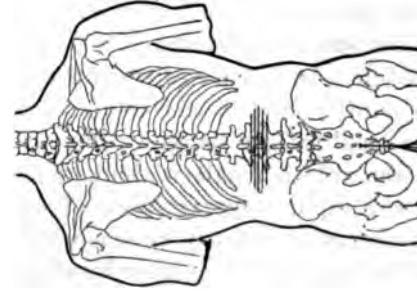


Fig. 6

FIG. 16.—Back areas of pain or tenderness.

FIG. 1.—Area in which the painful zones are most commonly met with in gastric neuroses.

FIG. 2.—Sharply localized areas in which the back pains of acute gastric ulcer are generally found.

FIG. 3.—Areas in which the pains of cholelithiasis are usually found: *a* is the common site, this area may be found farther up in the scapula region; *b* represents another point to which the pain in this condition may be referred.

FIG. 4.—Aching pain zones due to a loaded colon (constipation, colitis, lumbo-iliac, debility, and abdominal aneurism).

FIG. 5.—Site of pain in disease of the spleen.

FIG. 6.—*a*, pain area of renal colic, perirenal abscess, and neuralgia; *b*, diseases of the genitourinary organs, ulcer or cancer of the rectum, disease of the sacro-iliac joint, hemorrhoids, sacral neuralgia, and coccygodynia; *c*, pelvic disease.

being present close to or at the pylorus or in the duodenum. Kelling<sup>2</sup> considers this pressure-point as due to the supersensitive posterior branch of the intercostal nerves, by way of a reflex hyperesthesia from the sympathetic nerves. Care must be taken that the commonly present tender spinal areas (also found close to the spinous process but usually higher up) which are due to neurasthenia, disease of the spine or cord, infectious disease, and so on, are not mistaken for those due to ulcer. Any area in the back, which more diffusely covers a larger area over, at only one, or at both sides of the spine, is more liable to be due to the gastric neuroses. Such areas are usually to the left of the spine to a great extent, or in the infrascapular region on the left side. They are not so tender to pressure as the point areas of ulcer, and may be found shifting to different localities as the case improves under treatment. Occasionally, in gastric cancer the presence of a subjective back pain is described. Usually, the location in which it is found is in a transverse area about at a level with the twelfth dorsal vertebra. In these cases pressure upon this area rarely causes any distress.

In gall-bladder and liver disease, a painful area is commonly present in the back on the right side. It is usually diffuse, although in uncomplicated gall-stone disease it may be quite localized somewhere to the right of the eleventh dorsal vertebra and along the course of the last ribs. There may also be tenderness on pressure along the intercostal spaces of the lower ribs, this usually being present more at the posterior regions of the spaces. Also, in cholelithiasis a reflex area of pain may be present in the back of the right shoulder at the upper part of the scapula, and even in the front of the deltoid region just below the clavicle. In disease of the intestines, and particularly in loaded colon, coloptosis, and chronic colitis, a subjective transverse pain directly in the small of the back is commonly complained of. In enlargements of the spleen (malaria, leukemia) the dragging weight of the organ or the rapid overstretching of its fibro-elastic framework may cause a point pain midway between the spine and the thorax margin about at the eighth rib. Other locations in the back (with their causative conditions) in which pain is present are shown in Fig. 6 of the foregoing illustration (Fig. 15).

Palpation of the abdomen in the way of noting sounds in the stomach or colon which are caused by tapping strokes of the finger tips are of value in diagnosis. It must be remembered that any splashing sound obtained over the stomach or colon does not necessarily mean atony or stagnation in the stomach or likewise disturbed states of the colon. With fluid and gas present in either viscous, even a loud

splash may be obtained in a perfectly normal individual. Gas is normally present in the stomach during gastric digestion (chyme is fluid), and the intestinal contents are fluid in the ascending and often in the transverse colon where gas is also present. Leaving out of consideration the sounds produced in the colon, it must be said that there is some value in the diagnostic way to splashing sounds in the stomach. They are commonly found in cases of gastric atony when the stomach lacks in power to hold firmly against the gastric contents. In these conditions, because of the interference with the dynamic power of the stomach to expel its contents into the duodenum, and perhaps because of an existing neurotic disturbance with this, an increased fermentation takes place and the conditions favorable to produce the splashing or succussion sounds are then present. Likewise, in cases of pyloric stenosis from any cause, the long presence of stomach contents fermenting into gases some time after meals the symptom may be of value in a few cases as confirmatory of stagnation—particularly when this is found in the morning before partaking of food and drink. It may also be due to gastosuccorrhea of a high degree.

Of much more importance than its mere presence is to note the limits of the stomach area in which these sounds can be produced, and the position of the lower border of the stomach can often be made out by taking advantage of the presence of these sounds. To do this, it is advisable to approach the stomach area from below the navel in the median, then in the nipple, and also on a line between the two. Beginning over the intestines as you would, by a series of short, quick, gentle, downward strokes with a finger tip, and going up toward the stomach, a point is noted where with the same degree of force and depth of stroke the splash sounds are observed. A mark on the abdomen should there be made, and the performance repeated so as to obtain the accurate point. The gentler the stroke the surer you will be of the position of the greater curvature, for when a heavy stroke is employed much of the deep tissues beyond the finger are agitated and a splash in the stomach may be obtained when the fingers are some distance below the greater curvature. Sometimes in ptosis and marked atony the splash will be noted over the pyloric region until the lesser curvature is reached, when it is lost, although percussion should then be employed to observe whether the reason of this is due to the interposition of the left lobe of the liver, or whether the fingers are beyond the stomach proper—the liver being high in place. It is important to remember that a very general atony of the stomach is necessary to give splashing sounds at the margins.

States of less degrees of atony, such as are seen in ptosis and localized sacculations, would permit of splashing only in the body of the stomach, or fundic region just below the costal edge—in this manner, the splashing is of no diagnostic importance, since normal stomachs will also give it. It is best to use only one finger in these examinations, and have the abdomen relaxed by flexion and separation of the lower extremities and raising of the shoulders.

#### PERCUSSION OF THE STOMACH AND ABDOMEN.

In the prescribed percussion of the organs in the abdomen the distinctions to be made are between different degrees of dullness and tympanicity. With the exception of the area over the liver and spleen, the abdomen is normally tympanic with a pitch of resonant note varying in different patients according to the size of the hollow organs and the degree of distention within them. The stomach and colon under normal conditions give a lower pitched note than the small intestine; under marked distention, however, they may give a much higher one.

General distention of the abdomen as a whole is observed when there is much fat in the abdominal walls, when there is an excessive amount of gas in the stomach, intestines, or free in the peritoneal cavity, or when a large tumor is present in the abdomen.

When much abdominal fat is present, results from physical examination in the way of noting the presence of small sized growths, etc., are always doubtful. An accumulation of fat in the mesentery may simulate a median tumor or possibly a pregnancy in very adipose subjects. If the distention is due to ascites, in the dorsal position the fluid gravitates to the rear of the abdomen floating the intestines above it—therefore the flatness and bulging of the flanks, and the increased tympanicity in the center of the abdomen. If the latter patients are then placed upon the side, the previously uppermost dull flank becomes tympanic. In the rare cases of large-sized abdominal tumors the center of the abdomen is dull while the flanks are tympanic from the displaced hollow viscera. If the distention is due to gas in the intestines the entire abdomen is generally distended and tympanic; but the liver and splenic dullness is usually preserved—a point of much diagnostic value in decreeing whether the gas is confined to the gut or is free in the general peritoneal cavity (peritonitis).

In percussion of the abdomen it must be recollected that, as compared to the chest, the technique must of necessity be much finer in detail. In the chest we deal with very resonant lungs and a dull heart,

and the comparison between the two is always marked. But in the stomach for instance we deal with an organ which more than one-half is covered by the thorax, and most of the pyloric extremity and all of the lesser curvature are deeply seated and covered by the liver (normal position). Then again, all degrees and characters of distention are encountered from the full stomach dull from food or drink, and likewise dull when empty to those in which a height of tympany exists from distention with accumulated gases. These facts must

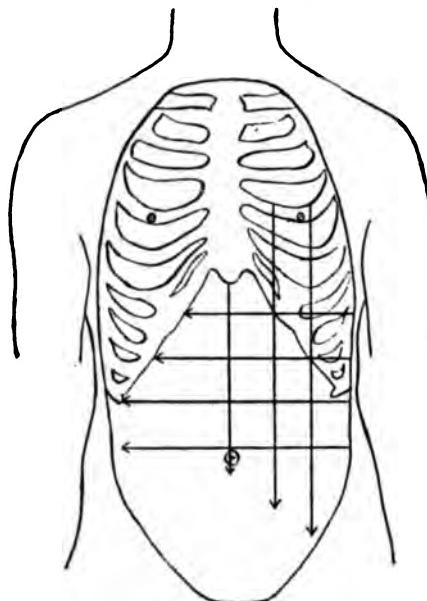


Fig. 16.—Showing a plan of systematic percussion of the stomach for the purpose of mapping out its size, position, and the location of growths.

all be taken into consideration in the percussion of the organ, and therefore it is essential to be cognizant of what and how much in the way of ingested substances may be present in the stomach at the time of examination.

The best results are always obtained by examination in the prone position with the lower extremities extended or only slightly raised. Occasionally, in a very slim subject with fluid in the stomach, it may be desired to note by percussion or palpation how low in the erect position the lower border of the stomach descends. In regard to this it may be said that any results possible to be obtained from examination in the erect position are usually somewhat questionable

## EXAMINATION OF PATIENTS.

In addition to X-ray observations with an opaque substance in the abdomen, the experience in diagnosing distended and dilated states of the stomach, the comparison between where the tympanic note of the upper border in the two positions is situated is of more value than examining for the position of the greater curvature—in the upright position the proximity of the transverse colon to the lower border of the stomach is often most confusing. Of more value than the last-mentioned position in examining a patient is to have him lie on the right side, because then most of the stomach fluids pass toward the rectal end and the pyloric extremity comes somewhat forward and thus is more accessible, and also it becomes distended with gas, so that the tympanitic note is distinctive.

**Technique of Percussion.**—Much has been written upon the technique of percussion and the desirable ways in which this should be done. Because of the value of this measure of physical examination of the stomach work the author will relate in some detail his experiences. The most complete results are obtained by a combination of finger percussion finished with the use of a pleximeter.

In finger percussion the applied finger should be pressed quite firmly, evenly, and transversely to the abdomen, and slid over the skin without slipping it over. The percussion movement should be from the wrist, with the middle finger held stiffly. The tip of only one finger should be used as the plexor, and it should strike the pleximeter at a right angle. The strokes should be equal in comparison and too frequently delivered, after which the striking finger should immediately be removed. The stroke should always be light and delicate (the gentler the better), because if it is heavy a confusing resonance from all of the organs in the vicinity is obtained. The sound produced should be just loud enough for the examiner to hear with his head bent low over the abdomen.

In the percussion of the stomach, the limits of the normal stomach should be kept in mind, the thorax and liver covering above and the close proximity to the transverse colon below. Practically, the normal stomach tympany begins at the side of the apex of the heart, about at the fourth intercostal space in the axillary region, extending below this into the abdomen so that its greater curvature extends from about the ninth costal cartilage, across the abdomen above the umbilicus to the right of the median line. The comparison of resonance between the dullness of the liver and the tympany of the stomach should be decisive.

Whether one begins by percussing the stomach from below or above is of no significance providing the entire stomach area is

examined in some routine way, and for this purpose it is wise to habituate one's self to following certain fixed lines in each instance, although it has been my custom to employ, and which serves the purpose well, those depicted in Fig. 16. As the margins of the stomach are outlined, the borders should be marked on the skin with a colored wax pencil. In this way the sagging and low-hanging stomach of gastroprosis and the large stomach of dilatation can be diagnosed and accurately recorded in position, shape, and size. To these ends, the percussing hammer is of some value particularly when the stomach has not been artificially inflated. It has been a regular experience with me that by its use somewhat finer work in accurately outlining the stomach borders is possible than with the fingers alone. While not recommending the use of a pleximeter in diagnosis for all percussion work—the hand method is to be preferred because it gives a

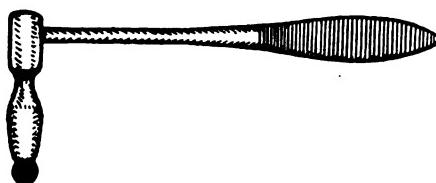


Fig. 17.—Vest pocket rubber-tipped pleximeter used by the author.

lower note and the sense of resistance under the hand is more accurately appreciated—still, in this single instance it has served me well and I believe is worthy of employment. In the very softest kind of percussion work, the stroke from the hammer can be more accurately gauged (so as to produce a slight blow) than with the striking finger, and one can be surer that the blow is delivered perpendicularly. The back end of an ordinary lead pencil held transversely to the abdomen and directly striking the abdomen without an interposing finger makes a handy and useful means of outlining a stomach and a cecum. It is not accurate enough for the other organs in the abdomen although often serves for careful percussion of the lower liver edge.

As a rule, ordinary percussion of the stomach is not trustworthy. Anteriorly, the surrounding structures, and the fluid and food substances in the organ interfere with obtaining definite results, and the covering of the left lung, body of the liver and structures making up the back interfere with it posteriorly. In the front, the tympany of the often overlying transverse colon, an overhanging enlarged liver, and the resonance of left lung confuse the examination. Thus it is, that measures of assistance—such as artificial inflation of the organ,

the accumulation of fluid in it, and the inflation of the colon of much practical value. In quite a few instances the examination can be made at the first visit without employing these, providing the organ is found to be distended with gases that have been generated. Sometimes, when in doubt, the simple procedure of causing the patient to drink a glass of water (Dehio) and, in the upright position, percussing for a transverse dullness, or noting fullness by palpation,



Fig. 18.—The method of stiff-finger percussion to obtain the percussive note and sense of resistance of underlying organs. Percussing the low edge of liver.

(when the abdomen is thin and relaxed) it may be possible to note the position of the greater curvature. According to Penzoldt, this point in the normal stomach should be above the umbilicus, and the stomach is atonic, below it—to the latter should be added the prolapsed stomach of gastrophtosis. One should hesitate in making a positive diagnosis of dilatation or prolapse by this water mark alone. The umbilicus does not bear the same ratio of distance between the ensiform and symphysis pubis in all persons, and a stomach with its lower border below the navel is not always one that is atonic or prolapsed. The determination of the upper border of the stomach likewise meets with many difficulties in unassisted palpation.

sion alone. Ordinary percussion, even over a stomach containing food, usually enables one to determine its fundic and upper left border.

A method which I have found of value in percussion of the upper part of the abdomen, as well as the chest, is by the vertically applied finger, percussing through the two phalanges of the middle finger and delivering the blow directly upon the proximal phalangeal joint. This method of stiff-finger percussion, makes possible percussion in a small area, and, after one has become experienced with it, a sense of organ resistance, such as the heart and the liver give. Not only can the left margin of the heart, mediastinal growths, aneurisms, tumors of the lung, and collections in the pleura be made out by it, but it is of value to note accurately the abdominal limits of the liver when the organ is soft and not pathological, the presence and limits of upper abdomen growths, and the position, size and shape of the stomach. Some experience is necessary to become perfect in this, but the time spent is worth the while.

The outline of the stomach is larger or smaller depending upon the various conditions. It is large in dilatation from any cause, in normally large stomachs, in long-standing gastrophtosis, in contraction of the left lobe of the liver and in pulmonic contraction of the left side. It is smaller in cirrhotic gastritis, in enlargement of the left lobe of the liver, in left-sided pleuritic effusion, emphysema and pneumothorax, and in splenic and heart enlargements. Lastly, simple percussion is an important physical measure in outlining tumors which may originate in the stomach. When much gas, fluid, or solid contents are present in the stomach the results obtained are always questionable unless the tumor is of large size. The measure is of more value in differentiating liver or pancreatic tumors from those of the stomach; because the first mentioned are always dull (the dullness of a pancreatic growth may be masked by a gaseous stomach even in the Trendelenburg position of the body).

#### AUSCULTATION OF THE STOMACH.

**Deglutition Sounds.**—With the ear or bell of a stethoscope at the ensiform, two sounds are ordinarily heard during deglutition. The first is a low sound occurring as the fluid passes through the lower pharynx into the esophagus and is called by Ewald the "primary murmur." This is followed by a "second murmur" which is much louder, like the cracking of a large bubble or a squirt, and occurs as the fluid from the gullet passes through the cardia into the stomach. The time between the occurrence of the two sounds is usually from

five to ten seconds, although in some healthy persons the interval shorter or prolonged beyond these. The first sound may be inaudible and when noting the intervals between them the raise of the larynx (occurring in the act of swallowing) can be timed in its place. The second sound is usually audible and best heard in the notch between the ensiform and the left costal margin. In a few instances it was observed best at the left of the tenth dorsal vertebra in the ninth tenth interspace.

The noting of the interval of time it takes fluids to course through the esophagus has been used with some degree of success in diagnosing states of stricture in the gullet or cardia and a lack of motor power in the deglutitory muscles (esophagus). Under these conditions (particularly stricture) the second sound is delayed and may not appear for half a minute or more, and the sound may be continuous for some seconds (due to only small portions of the fluid going through at a time). Some hesitancy should be used in making a positive diagnosis of the above-mentioned states on these sounds alone. I have seen normal individuals in whom the interval between the sounds was as long as twenty-five seconds, and, on the other hand, I have observed a case of quite general carcinomatous involvement of the esophagus (with some stenosis and a diffuse thickening of the canal) in which the sounds were but twelve seconds apart, and one of cervical stenosis in the upper third of the gullet in which it was ten seconds. When the sounds are heard depends much upon the force of the swallow, the amount of fluid sent down at one time, the length of the gullet, whether the stomach is empty of fluid or food and how much gas is in the upper (fundic) region, if the stricture is of large or small caliber, and the status of motor power of the canal. Still, it may be taken as a clinical fact, that if the second sound is heard inside ten seconds, stenosis in the course of the canal or at the cardia does not exist. Sometimes the absence of the second sound is of more value in noting stenosis of the cardia than the time in which it should occur. Manifestly, an irregularity on the surface of this orifice could divert the course of the fluid causing it to run down the side without passing through the organ and thus it might not be heard.

Recently a new swallowing sign has been described by Revidtzev which he considers of undoubted value in the diagnosis of organic stricture of the esophagus. Revidtzev's sign is based on the fact that in stenosis after the second sound is heard, if the individual is instructed to repeat the swallowing movements without taking in any fluid, the sound will again be heard. This may be repeated three or four times.

or four times in succession, each time with new sounds being heard. He describes the nature of this sign as follows: "There is always more or less dilatation of the esophagus above a chronic stricture through which a single swallowing movement is not sufficient to force all of the contents through and past the stenosis, a considerable portion of the fluid remaining above and each additional swallowing movement forces more or less of the material past the narrow portion of the channel. The more marked the stricture, the more numerous will be the residual sounds, unless, of course, the stricture be one that entirely obliterates the lumen." The discoverer of this sign believes that it is of special value in the differentiation of organic from spasmodic strictures. I have noted this sign to be present in five of seventeen cases of esophageal stenosis, and I think it has only a limited value. My experience was that it was most commonly found in the more or less annular strictures due to a cicatrix of long standing, but, as in malignant disease, sharply confined uniform strictured states are rare and dilatation above the stricture was not common; sometimes it was absent. The latter disease usually causes a quite general involvement of the esophagus, with much thickening of connective-tissue stricture above and below it, and still permits of a fairly rapid passage of fluids through the tortuous and roughened canal, but not the passage of foods or the olive of a bougie.

**Sounds in the Stomach.**—In the stomach itself sounds are often produced, which may be described as cracking or fizzing, rumbling or gurgling, the succussion sounds produced within the organ, and those transmitted to it from the heart.

A rather constant series of small crackles is often heard in states of active fermentation of foods due to stagnation of stomach contents. Their absence, however, should not be used to argue against the existence of abnormal retention, since even in extreme states of pyloric stenosis they may not be observed. Loud rumbling, bubbling, gurgling, or squirting sounds are often synchronous with respiration and may be heard some distance away. They are caused by the respiratory rise and fall of fluid, and (not so loudly) to the passage of chyme through the pylorus. These sounds are commonly heard in dilated stomachs or in gastrophtosis, but should not be considered as strongly diagnostic of these states, since they may also be heard in neurotic conditions and often in a normal stomach when empty. The succussion sounds are those of the foregoing, together with the form produced by the shaking of the body from side to side or the voluntary change of position of the patient. They resemble the agitation of a small amount of fluid in a cask, and are of diagnostic value in states of

atony and stagnation. The heart sounds may be transmitted through a stomach containing much gas. They are commonly encountered in gastric dilatation, or when much gas is present in the fermentative or gas-producing neurotic conditions. When observed, they possess a ringing reverberating quality like the muffled sound of a bell. It is probable that in a relaxed stomach containing gas, the underlying abdominal aorta could also easily produce them. Benedict has described another form of sound for diagnostic purposes to determine the degree of acidity in the stomach. These are generated by the giving of bicarbonate of soda, which, coming in contact with the acid in the organ, causes the sound of effervescence. All of the foregoing mentioned sounds are more significant when markedly present, and particularly when observed three or four hours after a simple meal, six or seven hours after the principal meal, or in the morning stomach before food ingestion. In these instances they are indicative of the delay of foods in the stomach from stenotic states at the pylorus, atony and excessive fermentation, or the existence of secretion of gastric juice in the empty stomach.

#### AUSCULTATORY PERCUSSION OF THE STOMACH.

The possibility of auscultatory percussion is made by the fact that different organs of the body have different densities of substance and character of make-up—solid, or hollow. As a measure of physical diagnosis, results from it are much to be preferred to simple percussion, but it has been my observation that for a relatively simple matter and easily learned, much difference exists concerning it between various medical men—in discouragement some even having given up employing it as a routine measure. This should not be so, because it is a fact that by its employment in the examination of the stomach the adventitious sounds of the overlying liver and lung may not interfere with its accuracy as in simple percussion, because the tympanitic sound of the underlying stomach is clearly transmitted through the organs. Like percussion, when both a distended stomach and transverse colon are present, it has its limitations in mapping out the lower border of the stomach. Still, ordinarily, the limits of the organ can be made out with precision, and often it is easy to detect the accurate site of the edge of the liver when it is too soft to feel by palpation, difficult to note by simple percussion. By care it is possible to map out the upper border of the stomach under the liver, and under the lung in the left thorax beyond the cardia to the limits of the fundus, although here it is rarely required. Auscultatory percussion of the

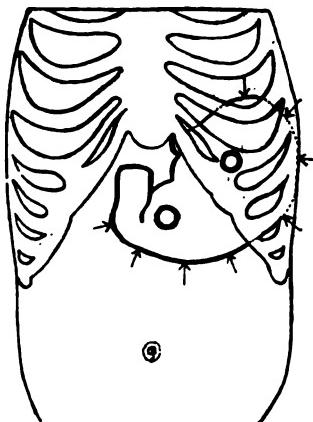


Fig. 1.

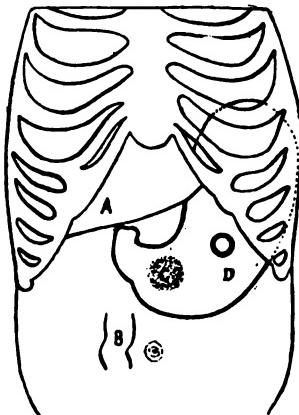


Fig. 2.

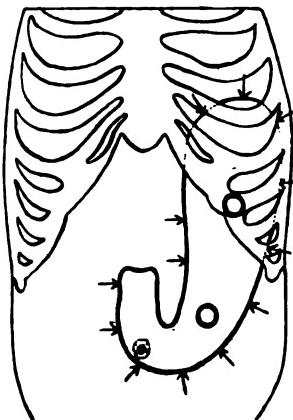


Fig. 3.

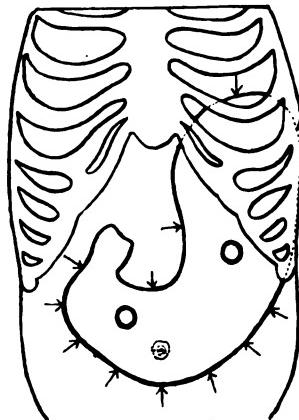


Fig. 4.

Fig. 19.—Auscultatory percussion of the stomach under different pathological conditions of that organ.

Fig. 1. Shows the two best positions of the bell of the stethoscope for percussion of the normal stomach. The upper circle for the limits of the fundus. The lower for the two curvatures and the situation of the pylorus. The arrows show the routes of percussion.

Fig. 2. Shows a method of determining by auscultatory percussion that a tumor belongs to the stomach rather than to the liver or intestine. If the tumor is in the wall of the stomach the percussion notes over points A, B, C and D differ, but C resembles D much more than does A or B resemble D. The author advises against pronounced artificial inflation in this examination.

Fig. 3. Shows the changes of positions of the bell of the stethoscope from Fig. 1, to map out the borders of the stomach in gastroptosis. The upper bell is lowered to the costal margin, and the lower one is swung downward and outward until it rests slightly inside of the outer transverse margin of the greater curvature (designated by gastric tympanitic note). The lower limit and pyloric portion of the organ can easily be made out from this position, providing there is not much food in the stomach, or under the conditions of sufficient inflation. Arrows show routes of percussion.

Fig. 4. Shows the best position of the stethoscope bell to map out a dilated stomach. The upper one is lowered onto the abdomen proper below the costal border, and the lower one is moved across to the right of the umbilicus. One is thus enabled to easily outline the stomach, especially when its contents have first been aspirated, and subsequently the organ is well inflated. Arrows show routes of percussion.

spleen to note its size may be more valuable than simple percussion. As Stengel has shown, and to which I fully agree, it is generally possible in tumor of the pyloric region to determine by auscultatory percussion whether or not it belongs to the stomach. Auscultatory percussion is easily carried out, and is of much value as a control to the ordinary method of percussion.

In beginning the examination by this method, place the chest piece of the stethoscope over the position below the fundus, at the sixth or seventh rib in the left mammillary line, or at the left side of the ensiform, and percuss near the stethoscope in order to fix in the mind the character of the stomach sound present. Noting this and maintaining the position of the stethoscope bell, percuss toward it from all positions beyond the stomach, starting well below, above, and to the sides of what may be considered as the limits of the normal stomach. It will be observed, when the stomach is distended with air or gas, that when the border of the organ is reached a sound of greater intensity, clearer and higher in pitch, is observed, and a mark should be made on the abdomen to record this. The stroke should be lightly delivered and best by the employment of a pleximeter, or by a process of scratching or rubbing the fingers over the skin. To confirm the results, percussion may subsequently be made from the stethoscope bell outward. By this method the position of the stomach area can be determined, although inflation may be necessary.

As changes in the shape or size of the organ are noted, the bell of the stethoscope should be moved to correspond more to the body of the stomach, according to the suggestions found depicted on the plate (Fig. 18), and the edges of the stomach approached with a still lighter percussion stroke, or skin noise. If the method is used to ascertain to which organ an epigastric growth is attached—whether in the posterior wall, or superior curvature, or at the pylorus—the organ should be moderately distended with gas and the small intestine should also be rendered somewhat tympanitic by waiting until some of this has passed out. Should the growth be in the liver or gall-bladder, the sound produced at A is quite different from that at C or D; while if it is in the small intestine, that at B is quite different from that of C or D (Fig. 19). Auscultatory percussion is quite valuable in differentiating malignant growths or enlargements of the gall-bladder and liver from those of cancer of the stomach. When doubt exists as to whether the tympany noted at the umbilicus is due to the lower border of the stomach or to distention of the colon, the placing of the stethoscope bell at the site of the transverse colon (slightly above the umbilicus in normal individuals and below this

when it is supposed to be sagged), and percussing along the course of the colon will usually clear this point. The sound at the colon is rarely the same as that of the stomach, and the difference noted, confirmed by special percussion of each organ, is of much practical value, since both organs are usually distended throughout in the same degree and thus the sound of each is characteristic and separate.

#### EXAMINATION BY MEANS OF THE STOMACH TUBE.

With the introduction and general utilization of the soft elastic rubber tube in the gastro-intestinal diseases, the possibilities of diagnosis and therapy have been placed upon a more rational basis. Practical facts obtained by means of the tube have made its use

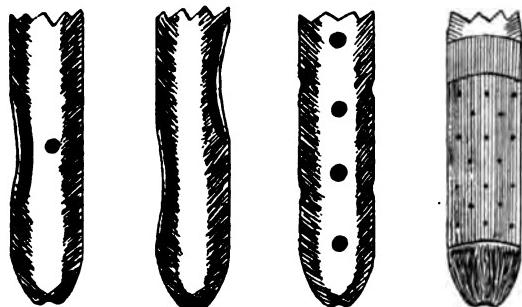


Fig. 20.—The end construction of the best forms of stomach-tubes. The Ewald and Boas tubes are used for test-meal extraction, lavage and gavage. The Rosenheim and Einhorn for douching the stomach.

indispensable, and after all has been said and written of the outside means of physical diagnosis one must usually resort to the use of the tube for the proper kind of work. By its employment, diagnostic aid is obtained in a direct way and therapeutic results are possible which will always maintain the tube's position as a most valuable single apparatus in the work. By its use in removing stomach contents, a study of the digestive process in the individual can be accomplished, the best form of treatment for many gastric conditions is possible, esophageal and cardiac stenosis may be diagnosed, and the position and size of the stomach can be noted, not to mention its many advantages in colonic work.

**Best Forms of Tubes to Employ, and Their Care.**—It has seemed to me (with the possible exception of esophageal work) that other than the soft form of tube should never be used. The employment

of the hard forms of apparatus or English sounds, used sometimes to determine the position of the lower border of the stomach, should be discouraged as an unsafe and unreliable practice. If in a thin and relaxed abdomen (through which it is possible to feel the location of the end of a stiff instrument), the soft tube arranging itself along the greater curvature can as easily be felt, and, for obvious reasons, is less dangerous to employ. This measure of so-called "sound palpation" can also be carried out in stout individuals (in whom the tube *in situ* in the stomach cannot be felt from without) by using a very soft, or old tube, the apertures of which had been occluded or covered over with thin rubber (condom) and which tube had been filled to about one-third of its length with a bismuth emulsion. With the end of such a tube in the stomach, and the employment of the X-rays and fluoroscope, its position along the floor of the organ can readily be observed, and the course that it had taken—which is always according to the depth and shape of the greater curvature—noted in the erect position (Bassler<sup>4</sup>). However, the swallowing of bismuth answers for the purpose much better.

A stomach tube, in my belief, should be soft enough to easily adapt itself to the curved course it must follow, and stiff enough so that it can be pushed downward without coiling or kinking easily in the mouth, pharynx, or stomach (it is my rule not to employ a tube which, when held up about 30 cm. (12 inches) from the fenestra, will not remain almost vertical). It must be composed of the usual elastic rubber composition, be on an average of about 75 centimeters long, and about 6 millimeters thick, have a conical end with velvet eyes to the apertures, and large enough openings to permit of easy passage of fluid. In children, a narrower and shorter tube should be used, and in very tall persons one about 100 centimeters long, but not any thicker.

A new tube should be used for each individual, and these should be cleaned after use and carefully dried before put away. In clinical work, where fresh tubes for each case is not possible, a set of tubes appropriately marked, can be used. The special tubes can be indefinitely marked with silver nitrate, and certain ones always employed in cases of cancer, tuberculosis, and syphilis. On every occasion the tubes should be boiled after use, and kept in an antiseptic solution (liquor creosolis compositus, or boracic acid) until used again. In hot and very dry climates, the tubes should be kept in a cool and moist condition, and when they are only occasionally used taken from the box or jar in which they are kept and shaken vigorously at least once a week. Some dusting powder such as powdered

talc, soapstone, etc., helps to preserve the tubes in dry keeping. Prolonged immersion in a carbolic solution or the coating it with petroleum jelly will often soften an old tube. It is best to keep them in a long box, rather than coiled in a jar; the reason of this is because after lying coiled up for a while they set permanently in the position they were in, and a tube for use should never have set curves of its own. The Boas tube with the two large fenestra is best for test meal extraction, with that of Ewald's a next choice. Both of these are likewise excellent for lavaging purposes, but for simple gastric spraying Türck's recurrent, Rosenheim's or Einhorn's are to be preferred. These latter are described elsewhere.

**Technique of Introduction.**—The introduction of a stomach tube is a simple performance, not attended with any danger in suitable persons, and to a great extent free from distress if properly and quickly performed. To those not familiar with its introduction, feelings of hesitancy and timidity usually cause more or less error and length of time that its passing takes, and consequently an increased degree of distress to the patient. The following points are offered to beginners for guidance.

Be sure that no contraindications for its use exist.

False teeth on plates had best be removed, although in apprehensive patients if these fit tightly they may remain.

If chronic pharyngitis or other tender throat conditions exist precede the introduction by a spraying of the throat with a 5 per cent. eucaine, or a 10 per cent. bromide of soda solution.

Lubricate the tube by immersion in water, or with glycerin, or both.

Do not put your fingers in the patient's mouth to guide the tube (it is unnecessary), but grasp the tube far enough from the end so that the tip can be pushed down into the pharynx without shifting the hand holding it (about 6 inches from the end).

Assure the patient that its passage is perfectly harmless, and advise him to swallow when you tell him to.

With the patient's head in a natural position, introduce the tube rather quickly and steadily, and when you feel the tip of it impinge at the back of the throat, rotate it to and fro, pushing it downward at the same time until it stops at the laryngo-pharyngeal junction, then ask him to swallow and at this time deliver it beyond that point.

Gaining the esophagus, push it downward quickly hand over hand into the stomach. Slow the rapidity of introduction as the stomach is reached insisting upon the patient taking deep breaths through the mouth so that he will observe that breathing is possible

with the tube inside. Should he incline his head backward push it forward.

Reassuring words to the patient during the performance often quiet apprehensive and nervous individuals.

In withdrawing the tube, pinch the outer end firmly so that its contents will not flow from the stomach end of it into the patient's mouth or soil his clothes.

The best position for the physician is at the side of the patient with one arm around the individual's neck so as to prevent the head from going backward, and the hand of the same arm in front of the face so as to assist the other in the introduction, and to hold it when in place.

A straight, high-backed, rather low and narrow seated chair is the best for the patient to sit upon.

With all patients unaccustomed to the passing of a tube, act as if its introduction was most familiar to you, and do not approach it as a first year medical school graduate would the performing of a laparotomy. Assistance is rarely required with the average patient, and with a little sangfroid or a perfectly natural demeanor on your part, the patient's fears are allayed, and the results obtained are more satisfactory.

**Contraindications to the Use of the Tube.**—The use of the tube for diagnostic reasons is not necessary in gastric cases that have an acute onset from a very possible cause; in gastric conditions which have existed for only a few days; when an apparently accurate diagnosis can be reached by the symptoms presented and the case is not severe in nature; when, under the diagnosis made and the treatment for the condition is being carried out, the patient benefits and recovery seems logical to expect; when severe gastric symptoms—such as actual pain, marked post-meal distress, vomiting, etc., do not exist, or constitutional symptoms—such as progressive anemia, debility, loss of weight, cachexia, etc., are not present; when the symptoms in an abdominal case are more suggestive of disease of the liver, gall-bladder, pancreas, spleen, intestines, kidneys, etc. than that of a primary gastric affection; and under the following contraindications:

When straining and vomiting are invariably caused by its passage and the case in nature does not seem to warrant persistence in its use.

In marked prostration from any cause.

In continued fevers.

In broken compensation of the heart from valvular lesions.

In advanced fatty or fibrous degeneration of the heart-muscle (chronic myocarditis), or angina pectoris.

In thoracic aneurysm, and advanced arteriosclerosis.

In recent hemorrhages from any source (stomach, lungs, kidneys, brain, etc.).

In advanced pulmonary tuberculosis, emphysema and severe bronchitis.

In plainly evident neurasthenia of a corporal type or in hysteria and epilepsy.

In pregnancy, during menstruation, and in old age.

When the clinical symptoms of gastric ulcer, gastric carcinoma, gastro-enteric neuroses combine to make a diagnosis of these conditions most probable.

When in disease of other organs, the gastro-intestinal conditions can be considered as secondary.

While the above contraindications should be borne in mind, occasionally in clinical work some liberties with them must be taken. Such a matter, of course, would depend upon the nature of the case, the condition present outside of the alimentary canal, and the desirability for gastric analysis of a test-meal or lavaging. In the estimation of these, the exercise of judgment and dictates of experience of the physician are factors of importance. Often, diagnostic facts for therapeutic suggestions and direct therapeutic results are of assistance in cases of many of the internal medical diseases. I believe that in diagnosing the clinical type of gastric ulcer, the tube should and need not be used, but I do not agree with Flade<sup>5</sup> and Boas<sup>6</sup> that its use is not always justified in any suspected or atypical case of ulcer. While obviously in these cases it would be wisest in a general way to advise against its use, and further, that usually little in the diagnostic way is gained by analyses of test-meals from these conditions, still, in a case of ulcer when the stomach does not present enough gross clinical symptoms to make a definite diagnosis possible, in some of the post acute gastric ulcer conditions and in the chronic forms of stomach ulcer, when skilfully handled and under favorable conditions, the employment of the tube is not attended with any danger, and occasionally the diagnostic and often the therapeutic results possible of being obtained by its use make it well worth the chance that is run—as was mentioned above, this always excepts gastric ulcer during the acute stage of its existence.

#### FRACTIONAL TEST-MEAL EXAMINATION.

Because the extraction of test-meals according to the Ewald method does not give an accurate reading of the status of affairs in a

continued way, Rehfuss and his collaborators in 1914 made fraction extractions of the contents of the stomach by means of a catheter, the distal end of which was attached a slotted metal capsule. By frequent aspirations he was able to plot curves of acid and ferment secretion, ascertaining the emptying time of the organ, gastric secretion with mucus, etc. The observations of Rehfuss are of the greatest practical importance, and offer a method for studying gastric digestion far more completely and accurately than the single test-meal.

Rehfuss determined that the former idea of the fasting content of the normal stomach was erroneous, and that secretion in amounts varying from 30 to 120 cubic centimeters are met with in normal stomachs. In addition to that, approximately 50 per cent. of normal stomachs in the fasting condition contained bile and trypsin regurgitate from the duodenum. Three types of secretory curves have been deemed normal—namely, the isosecretory, the hypersecretory or continued secretory, and the hyposecretory. Depending upon the rapidity of acid secretion, height of acidity attained, and the maintenance of the acid crest at the end of the digestive period, apparently there is not a universal type of curve for all persons.

This method of examination consists of the taking of an Ewald meal, promptly after which the Rehfuss tube is swallowed, and extractions of small amounts are made every fifteen minutes for at least two and one-half hours, each of these extractions being titrated generally by passing through thin gauze, and the acidity estimated. The method takes considerable time for the examination of one case and because of that it is somewhat difficult to conduct accurately ward work; but in private practice, particularly with an attendant who is familiar with the work, much worth the while in a diagnostic way can be gleaned. This method is described in detail in the next chapter.

#### INFLATION OF THE STOMACH.

Of much help in the determining of the size, shape, and position of the stomach, including an outline of the greater and lesser curvature, and often the pyloric extremity, is the artificial ballooning of the organ. By this distention of the stomach, the examination in short or stout individuals, or when the stomach contains too little gas to elicit a distinctly tympanic note, is rendered much more simple and accurate. Among some of the decided benefits possible of being obtained in the diagnosing of stomach affections under conditions of inflation may be mentioned the following: the shape, size and position of the organ from the costal margin downward can usually

be brought into prominence in the abdomen. In this way, a dilated organ, by its large size, can readily be observed; also, the prolapsed organ with the pyloric region prominent about the umbilicus can be seen and easily percussed. Of still greater value is the institution of visible peristaltic movements seen under conditions of distention and not visible under ordinary conditions. In tumors of the anterior wall and pyloric region of the stomach the growth may be seen to move to the left of the midline and become more prominent; this is an important point in the differentiation of tumors situated or attached to the anterior portion of the stomach and those to the back wall, lesser curvature and deeply seated post-gastrically, for the tendency would be for the deep-seated growths to become less easily palpable or disappear altogether—this is particularly true of tumors of the pancreas, left kidney, or transverse mesocolon. Dilatation of the colon may be practised by means of a soft rectal tube and air forced through it by means of an atomizer bulb, and such diagnoses as rectal and colonic obstruction, prolapse of the sigmoid, gastric flexure and transverse colon, the presence of adhesions, site of a tumor or tender spot, and the presence of chronic appendicitis by the Bastedo diagnostic method, made possible in some instances. To these ends for the stomach conditions, one of two methods is employed, either the carbonic acid inflation with effervescent mixtures, or by means of a stomach tube and some apparatus to drive air through it into the stomach.

**Effervescent Mixtures.**—The first is ordinarily accomplished by the administration of 4 or 5 grams (1 dram) of tartaric acid dissolved in half a tumbler of water, which is followed by an equal quantity of sodium bicarbonate dissolved in a like quantity of water. The chemical action between the two dissolved substances causes the liberation of free carbonic acid gas, which, collecting in the stomach, distends the organ. The drawbacks to the employment of this method of distention are important to keep in mind; the distention often occurs too quickly, is beyond control in its degree, and can only be relieved by immediate belching or the passing of a stomach tube to relieve the intragastric pressure. Even with only four-gram doses of each of the ingredients in the mixture, a marked amount of distress may ensue, or even hemorrhage or cardiac embarrassment, not to mention the danger of perforation should an ulcer exist in the stomach walls or perigastric adhesions be present.

It is natural for any physician to desire on the first visit of a patient that as many details of information be gained as can be. This, particularly in the quick rush of clinic work, would incline him to employ this ready-to-utilize aid to diagnosis. As case

after case comes along, some with empty stomachs, and some stomachs more or less filled with fluids or foods, the natural tendency would be to employ the effervescent method, because it is simple quick, regarded as harmless, and does not require the passage of a stomach tube to bring the distention about. While, as above described, it was a method common with me for several years, and I may say it had never caused any serious immediate harm, there were enough unpleasant experiences with it to make me modify it severely. Another object for doing so was that one could never be sure, for obvious reasons, that the stomach of the patient was empty of food contents; one cannot by physical means observe that a stomach, we will say, is half filled. When the patient is in the upright position to drink these solutions, all of the gastric contents sink to the lower and pyloric regions, and it is only in the upper part of the stomach that the manufactured carbonic acid gas can collect. Assuming now for the purpose of reasoning that the capacity of that stomach is 250 cubic centimeters, and that it contained 1250 cubic centimeters of food on top of which was added the tumbler of water (250 cubic centimeters more) making 1500 cubic centimeters of non-displaceable contents in all, it must be plain that all of the gas generated would have to collect into the 1000 cubic centimeters of space in the fundic end and this accounts for the sudden unpleasant effects sometimes seen, in which the patient turns pale, gasps for breath, and cannot lie down until an accommodating cardia has relaxed, expelling some of the gas, and the pressure upon the diaphragm displacing the heart forward has been relieved by the belching. I think that the employment of larger amounts of tartaric acid and sodium bicarbonate as has often been recommended is a dangerous practice. To somewhat guard against this, in all instances, I suggest the following: With both solutions ready, about one-half of the bicarbonate of soda solution should be drunk, and the patient lying down, percussion be made. Should the gastric tympany not be sufficient, the other half is now taken and percussion again performed. In most cases sufficient HCl content is present in the stomach to generate enough gas for examination. If however, this is not so, the tartaric acid solution can then be taken first one-half and then if necessary the remainder. In this way we never cause distress, never overdistend an atonic stomach, obtain a fair idea whether hydrochloric acid is present in that stomach, and how long so after meals (myasthenia, states of increased gastric juice secretion), and even have suggested a diagnosis of marked stagnation with formation of organic acids usually found on these occasions, since such acids will also decompose the bicarbonate of soda (cancel).

pyloric stenoses). In the latter instance the formation of carbonic acid gas is slower and not so complete as when the tartaric acid had been taken, or HCl was in the stomach.

**Inflation by Means of a Hand Bulb.**—The second and decidedly better method for distending the stomach is by means of a stomach tube and bulb. This method was first recommended by Runeberg, and can be utilized in the recumbent position of the body. It possesses the disadvantage of having to use a stomach tube, as by it the quantity of air delivered into the organ can be nicely regulated, and

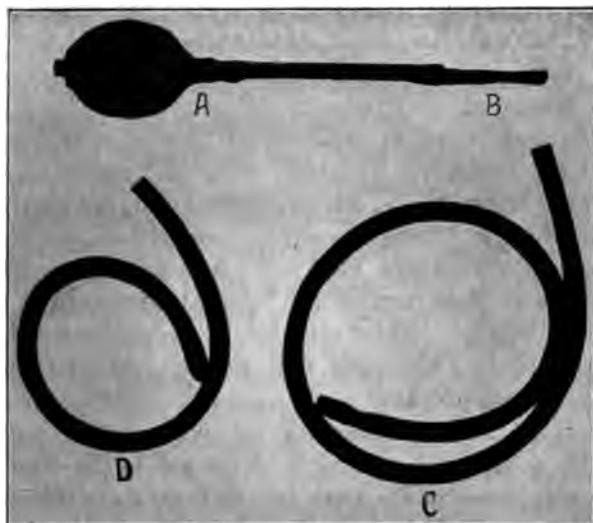


Fig. 21.—Inflation apparatus used by the author. *A*, Inflow bulb and tube such as is supplied with an ordinary atomizer. *B*, Short glass tube for connecting same with stomach tube (*C*) for inflating the stomach, or short colon tube (*D*) for inflating the colon. For the stomach any of the duodenal tubes with large fenestra in the tip serves better than the larger calibred stomach tube.

after the distention (by removal of the bulb attachment) the stomach can be relieved of the pressure. Of late one of the small forms of catheter tubes is used, the same as is found on any of the various forms of duodenal tubes, any of which apparatus serves admirably for the purpose of in- and deflation if the tip openings are large enough (as are found in the Rehfuss or Lyon tip ends). By this method, the air can be so regulated that the stomach can actually be felt in thin and medium subjects, and distinct palpation of the pylorus may be possible.

In the foregoing examinations it is most desirable that the stomach be empty of food contents, and with the employment of the bulb

inflation, it is a good practice to instruct the patient to, by some pre-arranged signal, make known when any sensation of pressure, distress, or pain is experienced; at which time no more air should be pumped in, or in the event of the distress continuing some left out. In the ordinary run of gastric work it is not necessary to employ more than about 350 cubic centimeters of air for good results in examination. With a bulb having a capacity of about 70 cubic centimeters (the usual size) the delivering of this amount is accomplished by from 5 to 7 squeezes of it. By the employing of the author's test-meal bottle this method of inflation can be expeditiously carried out after the extraction of a test-meal, requiring thus only the single passage of a stomach tube for both purposes. Boas advises for the purpose the use of a double bulb. This is hardly necessary when a properly working single one is employed.

The contraindications to inflation are gastric ulcer, marked atony, adhesions of the stomach walls, and cardiac disease, to which must be added, when the stomach tube method is employed, the presence of those conditions in which its passage would be injudicious.

Occasionally, cases are met with in which after inflation the stomach rapidly empties itself of air, suggesting naturally a deficiency of the pyloric closing. While such might be the cause of the condition, it is rare to find clinically that the pylorus of those stomachs does not functionate properly when food is present in them instead only air; thus it may be necessary to give a little food before the inflation, so as to have the pylorus hold the gas in the organ. In other instances again, immediately after an inflation, a rapid series of belching so quickly empties the stomach that results from the method are modified. After a little practice and instruction, patients can usually control this satisfactorily. After inflation, examination, and marking the stomach outlines, aspiration of the stomach is desirable so that it is again collapsed. Inflation of the colon can be made by means of the same bulb attached to a colon tube. In this way the colon can be better examined to clear any doubts that may exist as to its relation to the stomach, and to which organ epigastric growths may be attached.

#### GASTRODIAPHANY.

Translumination of the anterior wall of the stomach by means of a small incandescent bulb introduced within the organ deserves mention as one of the methods of estimating the position of the lower curvature and the shape of the organ. In the rare instances of

growths involving the anterior wall its use may be of diagnostic service.

According to Einhorn, who advanced the first form of instrument for the purpose of stomach work and who at the time attached much practical importance to its use, it is a quick method of diagnosing states of dilatation and prolapse, and is of value to detect tumors of the anterior wall by their translucency. In all of these conditions, after a rather general and continuous employment of this method of diagnosing, I must say that its use is limited, and not to be preferred to the X-ray method, or physical examination when carefully performed. Much depends upon the slimness of the subject, and how marked in degree

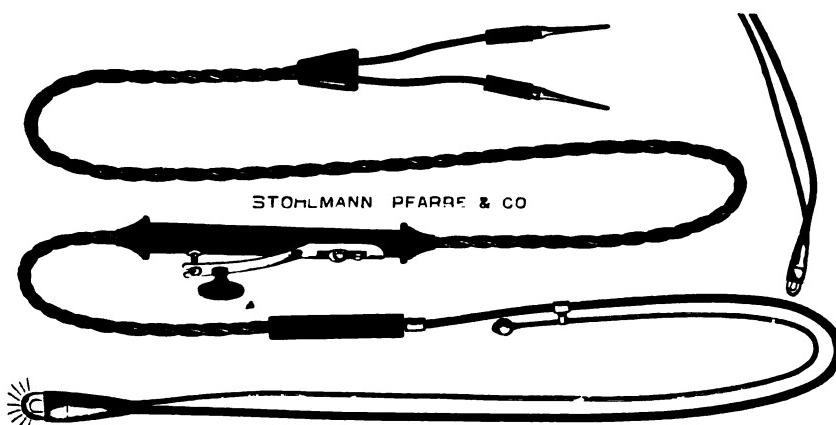


Fig. 22.—Kemp-Lockwood circumscribing gastrodiaphane.

is the dilatation or the gastrophtosis, for it is plain that when the patient has considerable subcutaneous fat on the abdomen (commonly encountered in gastrophtosis as well as in other gastric conditions) only a very indistinctly illuminated area is seen, and often no light at all excepting when the bulb is in the pit of the organ or near the anterior wall when an area about the size of the palm of the hand is observed and all else is dark. It must be quite apparent that when the area of light is brilliantly seen well below the umbilicus, states of enlarged or prolapsed stomachs are strongly suggested, but as a rule in practice, mapping out by means of the light the size and shape of the organ requires some degree of imagination to carry one completely in the diagnosis. The same limitation exists in noting the pyloric region, and when too much dependence is placed upon the observations made here, error in diagnosis is very liable to occur. The pyloric extremity of the human stomach is very deeply situated, and, when not pro-

lapsed, is snugly covered over by the left lobe of the liver. Consequently, satisfactory translumination of this area is often impossible, particularly as the bulb, even when the instrument is introduced deeply, is liable to course upward to the lesser curvature some distance from the pylorus itself. Then again, when the light is in this portion of the organ, it is so faintly seen from without, that details in the diagnostic way as to the exact position of the pylorus, and whether growths exist, are usually impossible. The author's use of the gastrodiaphane has brought him to the following conclusions:—

It is a means of quickly noting the location of the greater curvature in about half of the cases.

In thin subjects and under favorable conditions a diagnosis of the shape and degree of prolapse of the stomach may be possible.

Taking a previously marked position of where the location of the greater curvature had been as a guide, progress in cases of gastritis or dilatation can be noted, although physical examination answers.

In cases of growths at the pyloric region its employment may be of a measure of confirmatory value, also in differentiating those of the gall bladder from those of the stomach.

Excepting in tube broken subjects, the Einhorn instrument is, because of the thickness of the tubing and the length of time that these examinations take, is not as pleasant to use as the modified forms of Lockwood or the Kemp-Lockwood instrument (which are much thinner and stiffer); and it is of additional value that the Kemp-Lockwood instrument, because of the accessory cable, is of service in moving the light from the greater curvature and along the lesser to the cardia under better control than with instruments not so supplied.

Before beginning translumination the stomach must be empty and preferably lavaged. It is to be recommended that the intestines (particularly the colon) be empty by previous purgation and fasting. A totally dark room in which to conduct the examination, and a battery capable of delivering sufficient current to brilliantly light the bulb are essential. The patient is examined in the upright position after swallowing one or two tumblerfuls of water so as to separate both walls of the stomach and facilitate the migrations of the instrument within the organ. The instrument is introduced quite the same as a stomach tube. I have preferred to first turn on the current until the proper glow in the bulb is obtained, and introduce the instrument while so lit. My reason for this is that one could always be sure that the bulb was aglow in the stomach even when this could not be observed externally, still, with an apparatus in good working condition and the employing of a rheostat this is not over important.

When the instrument is introduced, and the form illustrated employed, the flexible cable is then drawn upon to cause the bulb to move in a circular manner toward the cardia, and depending upon which way the bulb points on the floor of the stomach the pyloric or fundic portions would be better illuminated. It is important to remember, as Renvers has shown, that the transverse colon, which borders the lower line of the stomach, is also transparent to this light (shown by a crescentic area), and that the commingling of this area with that of the stomach site may lead one to believe that the lower border of the stomach is lower or higher than it actually is. The muscular planes of the abdomen and abdominal vessels in the wall also show confusing shadows, and fecal masses in the large intestine may give shadows closely simulating gastric tumors. As a method the X-ray has supplanted it absolutely, and justly so.

Kemp advised to increase the illumination of the stomach the employment of an alkaline glycerin solution of fluoresceine instead of plain water. For this purpose he first gives the patient a glass of water in which 15 grains of bicarbonate of soda had been dissolved, after which is given the second glass of water containing one dram of glycerin and about  $\frac{1}{6}$  of a grain of fluoresceine. Having employed this method on several occasions I believe it to be an improvement over plain water, but still its use leaves gastrodiaphany far short in noting the size and shape of the stomach by the better results to be obtained by the older method of physical examination of the inflated stomach, and the still better X-ray method.

#### ROENTGEN RAYS IN THE DIAGNOSIS OF STOMACH DISEASES.

The advent of the X-rays in the art of medicine constitutes the most forward advance in recent times. While one could hardly enter upon the writing of this subject without also including some remarks upon its great value in the practice of surgery, dermatology, and the diagnosing of other than abdominal conditions, logically, in such a work as this, only the latter need be considered. When by the assistance of bismuth instillations into the stomach Rieder<sup>7</sup> was enabled to make accurate negatives showing the size, position, and form of the stomach, a way was opened in its employment for the diagnosing of gastro-enterological affections which has made it the most valuable single measure of diagnosis at our command. From a method which was first supposed to have but little more virtue than locating

foreign bodies of a metallic nature, the results to-day from its employment in this field of medicine may briefly be said to be as follows:—

It is of much confirmatory value in diagnosing states of the esophagus (malignant disease, cicatricial strictures, diverticula, extra-esophageal pressures, cardiospasm, and dilatations).

It is the most accurate method of diagnosing the size, shape, and form of the stomach (dilatations, cirrhotic gastritis, gastrophtosis, hour-glass contraction, the binding down of perigastric adhesions, etc.).

It is a simple method of observing the presence of obstructive disease situated anywhere in the alimentary canal (cancer, cicatricial contraction, etc.).

It is a most useful method of diagnosing abnormal states of motility and mobility of the stomach (hypermotility, loss of tone, stagnation, the uplift possible to be obtained by artificial means in a gastrophtosis, etc.).

It is often of value in directly diagnosing growths in the stomach walls, their size, mobility and location, and the pressure of extragastric growths upon the stomach.

Its use shows the presence of swallowed metallic articles located anywhere in the alimentary canal (when these are of some size).

It is also of value in diagnosing the presence of gall, renal, uretal and enteric calculi when these have calcium in their make-up, and adhesions connecting the stomach with surrounding organs or structures.

It is the best means for noting intestinal stases, position and size of the small and large intestine, pathological states of the appendix, enteric stenoses, new growths in the intestines, and conditions of the sigmoid and upper rectum.

It may be used in noting the position and size of the kidneys, in the way of diagnosing renal tuberculosis, new growths, and nephrophtosis.

**The Normal Esophagus.**—Beginning the consideration of the X-ray diagnosis, a few remarks on the course and shape of the normal esophagus and position and form of the normal stomach are in order. The esophagus commences at the upper border of the cricoid cartilage, descends along the front of the spine through the posterior mediastinum, passes through the diaphragm, and, entering the abdomen, terminates at the cardiac orifice of the stomach, opposite the tenth dorsal vertebra. The general direction of the esophagus is vertical, but it presents two or three curves in its course. At its commencement it is in the median line, from which it inclines to the left side as

PLATE VI.



Roentgenograph of a normal esophagus in the adult, taken in the half-lateral position with the left side of the patient in contact with the plate. The spinal column is seen at the left; the esophagus, with the course it takes downward and its dilated lower end emptying into the stomach, below the left dome of the diaphragm in the middle, and the lungs at the right half of the picture. The darkened zone across which the lower end of the esophagus lies is the right dome of the diaphragm. (Made in the author's X-ray department.)



PLATE VII.



Roentgenograph of the normal stomach in a male adult. The two curvatures, the longitudinal running rugæ, the pylorus some distance to the left of the spinal column, and the gas collection at the fundus are shown. The upper marker represents the ensiform, and the lower the umbilicus. In the female the normal stomach is somewhat wider, the body of the organ dips deeper into the abdomen, and the pyloric region ascribes somewhat of an upward course. (Made in the author's X-ray department.)



PLATE VIII.



Roentgenograph of a normal stomach, showing the gas collection at the fundus, course of the organ downward to the under surface of the liver, and the point at which the most marked waves of peristalsis begin, which is noted by the slight depression about half-way down on the lesser curvature. (Made in the author's X-ray department.)



far as the root of the neck, gradually passing to the median line again, and finally again deviates to the left as it passes forward to the esophageal opening of the diaphragm. It also presents an antero-posterior curvature, corresponding to the curvature of the cervical and thoracic portions of the spine. It is the narrowest part of the alimentary tract, being most contracted at its commencement and below where it passes through the diaphragm. When, however, food is being swallowed, the cardiac end is its largest part, being quite funnel-shaped. As a rule, even under conditions of rest, and, of course, during swallowing, it is not of uniform caliber (particularly when viewed from the side). It is usually somewhat larger at the base of the heart, at the upper margin of which it is quite narrow, and it then spreads out again, gradually increasing in size to its lower end. (See Plate VI.)

**The Normal Stomach.**—In the recumbent position the stomach is situated at a higher level in the abdomen and is somewhat different in

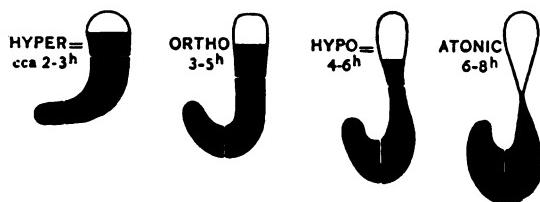


Fig. 23.—Diagrammatic representation of four types of stomach found in individuals who may present no gastric symptoms—hypertonic, orthotonic, hypotonic, and atonic. The figures represent the number of hours in which these various types of stomach empty themselves. (Schlesinger.)

shape than the same stomach when the body is upright, particularly when it contains food or fluid contents. It is this raising of the stomach to the higher plane, the gravitation of fluid contents to the posterior surface of the organ, the accumulation of the contained gases between this content and the anterior wall, together with the relaxation of the tone of the abdominal muscles which makes the results of percussion of the organ in the recumbent position so much better than in the upright. Therefore it is important, since most of our active life is carried on in the upright position, that we determine the form and position of the stomach in this position. The Roentgen method is the only accurate means of obtaining this information.

Quoting Pfahler,<sup>8</sup> whose observations may be taken as a standard for practical use, the normal stomach is described by him as follows: "The normal stomach when empty or moderately filled occupies the left side of the abdomen, and extends from the inner two-thirds of the left dome of the diaphragm to the median line, usually about an

inch above the umbilicus. The upper two-thirds is almost vertical, and the lower third almost horizontal, making the general directions of the stomach slightly oblique. The stomach of the average individual in the standing posture extends to or below the umbilicus, the pyloric portion extends from one to two inches beyond the median line to the right. I believe there is no difference in general between the normal stomach of the child and that of the adult." To this, in which I closely agree, I wish to add that the normal stomach of women is generally found to be somewhat lower than in men—this pertains



Fig. 24.—Roentgenograph showing the position of the normal stomach and transverse colon. Note that the greater curvature of the stomach is well above the shadow of the coin at the umbilicus, and that even the transverse colon is above it. The upper coin represents the location of the ensiform process (*Pfahler.*)

only to the pyloric one-third—and also that the stomach of the average woman is different in shape from that of men—longer and less horizontal across the abdomen.

**Roentgenographic Observations of the Abnormal Stomach, Etc.—** Both the fluoroscope and the photograph, X-ray plate are used in making these observations. The first method may be used to observe the peristaltic function of the esophagus and stomach, and under favorable conditions, to observe the shape, size and movements of the stomach and the colon. If a patient swallows a capsule of bismuth it will usually lodge for a second or two at the level of the arch of the aorta and then pass quickly into the stomach. Should it lodge for

PLATE IX.



Roentgenograph of the chest and upper abdomen of a normal woman, showing the lungs with the bronchi entering at the roots, the heart and aorta, the liver, and the stomach and duodenum, and the topographical relation between these various organs. Marker at the ensiform. (Made in the author's X-ray department.)



PLATE X.



Foreign body lodged in the upper part of the esophagus. Anteroposterior X-ray showing the tooth plate lodged at the level of the third and fourth dorsal vertebræ, where it had been for ten weeks. Removed by esophagostomy. (Made in the author's X-ray department.)

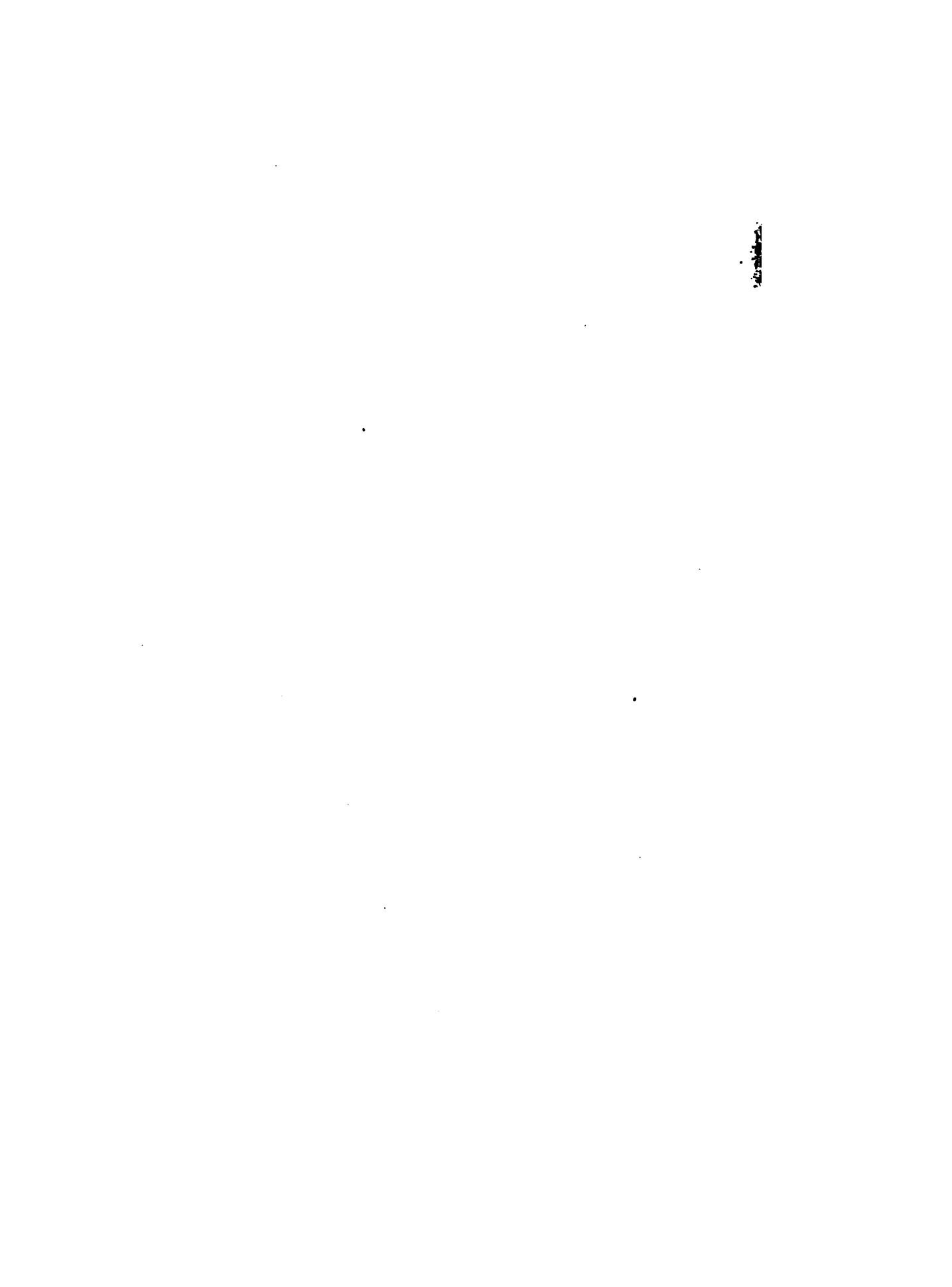


PLATE XI.



Moderate pressure upon the esophagus by a calcified arch of the aorta at *A*, and enlargement at the base of the heart at *B*, causing a retention in the esophagus between these two points. Stomach at *C*. (Made in the author's X-ray department.)



PLATE XII.



Cardiospasm with secondary dilatation of the esophagus. (Made  
in the author's X-ray department.)



PLATE XIII.



Left two, diverticulum of the esophagus. Right, diffuse dilatation of the esophagus in cardiospasm. (*Plummer.*)



PLATE XIV.



Benign stricture of the esophagus about 7 cm. above sternal notch. *A*,  
tion of stricture (note thickening of the esophageal wall in this locality).  
ismuth suspension inside of casing. (*W. H. Stewart, New York City.*)

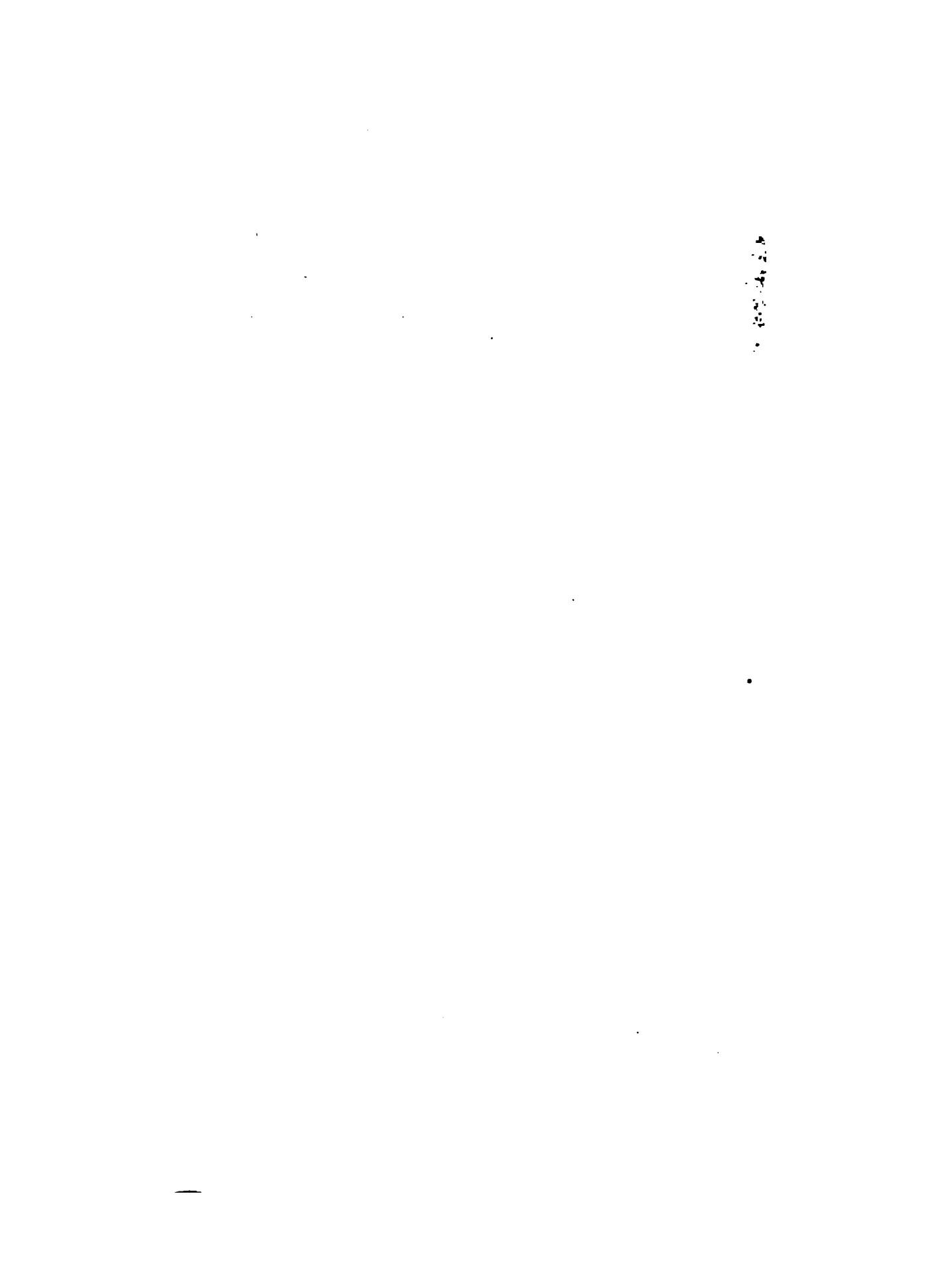


PLATE XV.



Malignant disease of the lower part of the esophagus, showing the stenosis with slight dilatation of the esophagus above it. The light area below the carcinoma represents gas in the fundus of the stomach. The arrow points to the stricture. (Made in the author's X-ray department.)



PLATE XVI.



Malignant disease of the middle of the esophagus. (Made  
in the author's X-ray department.)

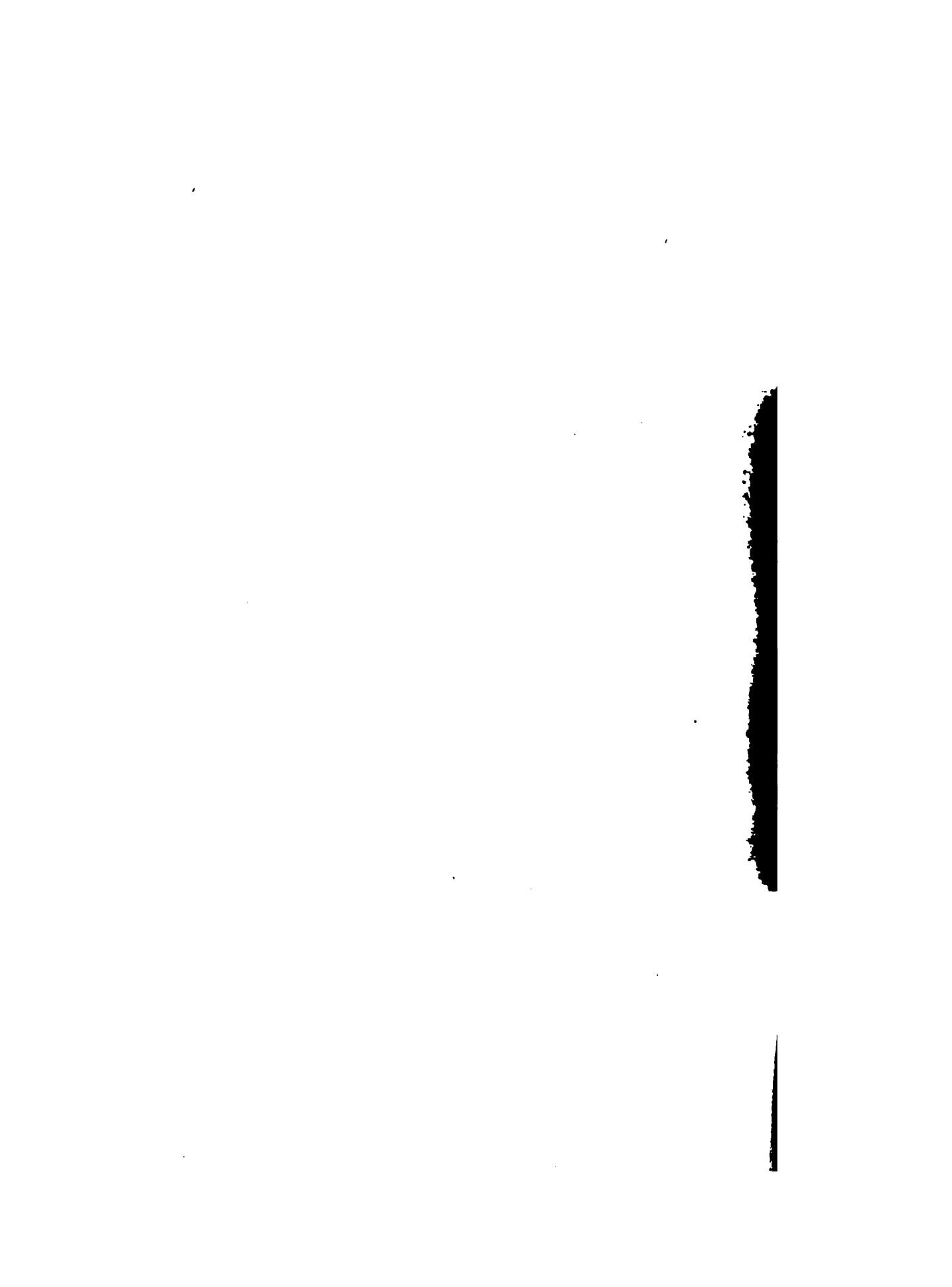


PLATE XVII.



Carcinoma of the esophagus made by Dr. G. E. Pfahler, Philadelphia. The upper level of the carcinoma is indicated by an arrow, above which is an accumulation of bismuth.



PLATE XVIII.



Ulcer of the posterior wall of the stomach proven by operation. Barium fills the ulcer crater (arrow). Observation made two hours after ingestion with pressure on epigastrium. (Made in the author's X-ray department.)



PLATE XIX.



Acute ulcer of the anterior wall. The stomach is shown large in size, and, beginning at the diaphragm, will be seen gas at the fundus, rugae below this, the ulcer in the light area, and the pyloric region containing most of the bismuth and showing a hypermotility, the latter being noted by the gyrations of the peristaltic waves and the rapid exit of the bismuth into the duodenum. The isolated dark area to the right of the spine and above the pylorus marks the first part of the duodenum. (Made in the author's X-ray department.)



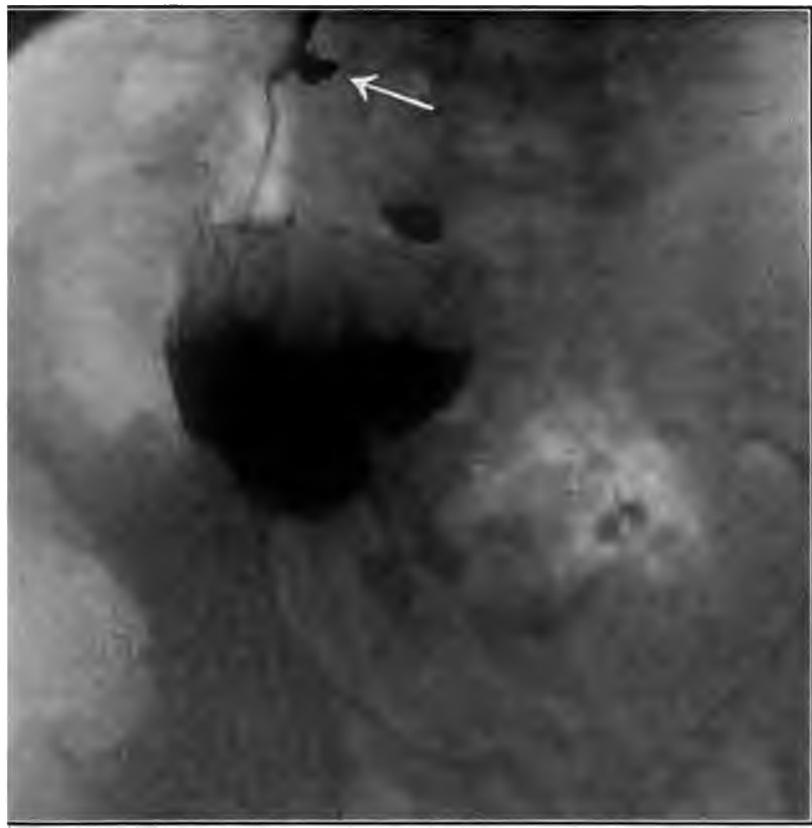
PLATE XX.



Penetrating ulcer of the lesser curvature. (Made in the  
author's X-ray department.)



PLATE XXI.



penetrating ulcer of the lesser curvature. Sac partly filled with barium and upper half with gas. (Made in the author's X-ray department.)



PLATE XXII.



A peristaltic niching that often is mistaken for ulcer of the lesser curvature.  
It is often met with and of no significance when not permanent and not  
accompanied by distinct clinical symptoms of ulcer. (Made in the author's  
department.)



PLATE XXIII.



Complete pylorospasm due to ulcer of pylorus in posterior wall. Proven by operation. (Made in the author's X-ray department.)

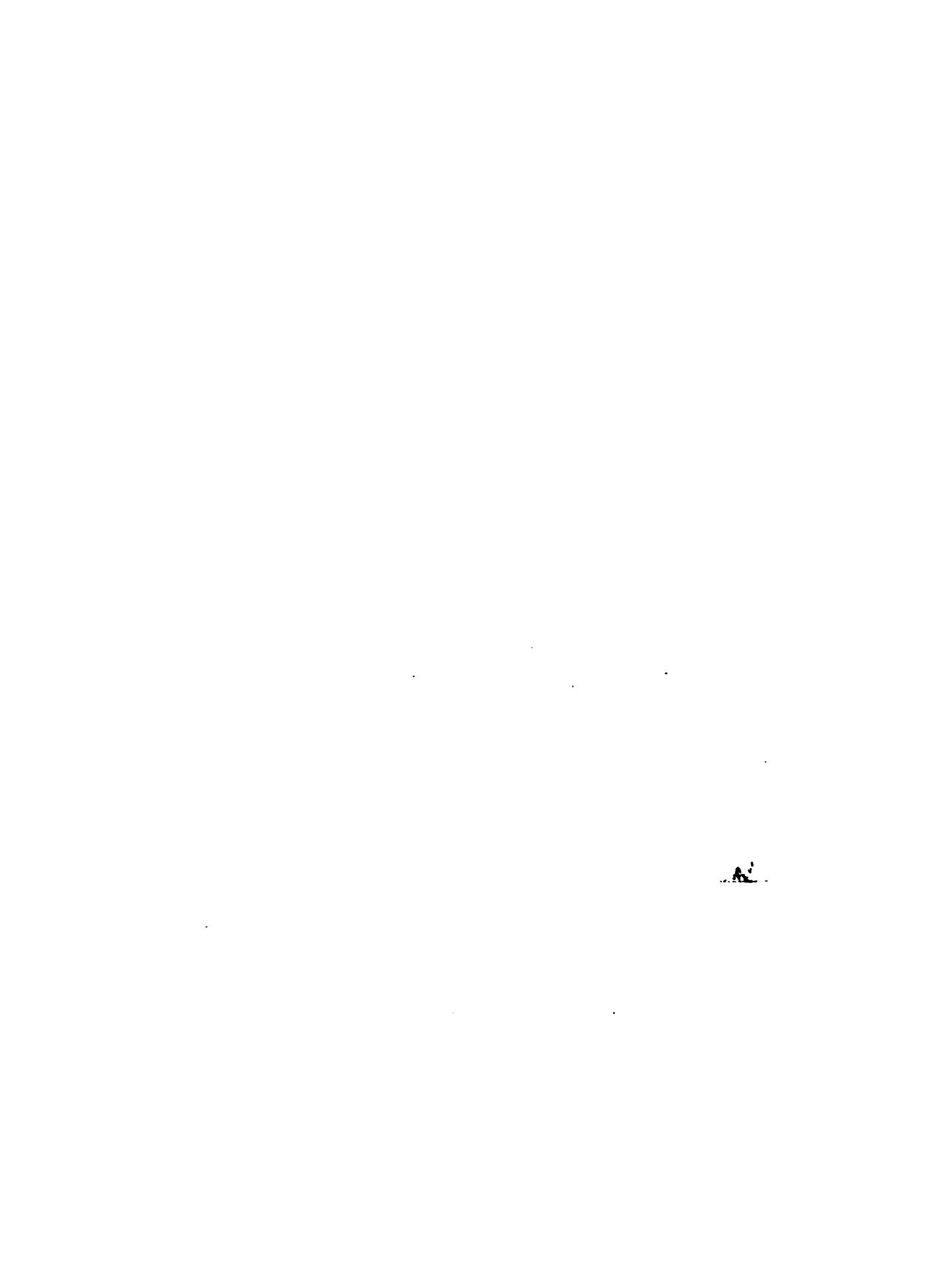


PLATE XXIV.



Hour-glass stomach, due to ulcer which is of the penetrating type.  
(Made in the author's X-ray department.)



PLATE XXV.



Duodenal ulcer. Confirmed by operation. (Made in the  
author's X-ray department.)



PLATE XXVI.



Ulcer of stomach and duodenum. *A*, Incisure at site of gastric ulcer. *B*, Filling defect of duodenum. Site of duodenal ulcer. Diagnosis proven by operation in New York Polyclinic. (Made in the author's X-ray department.)

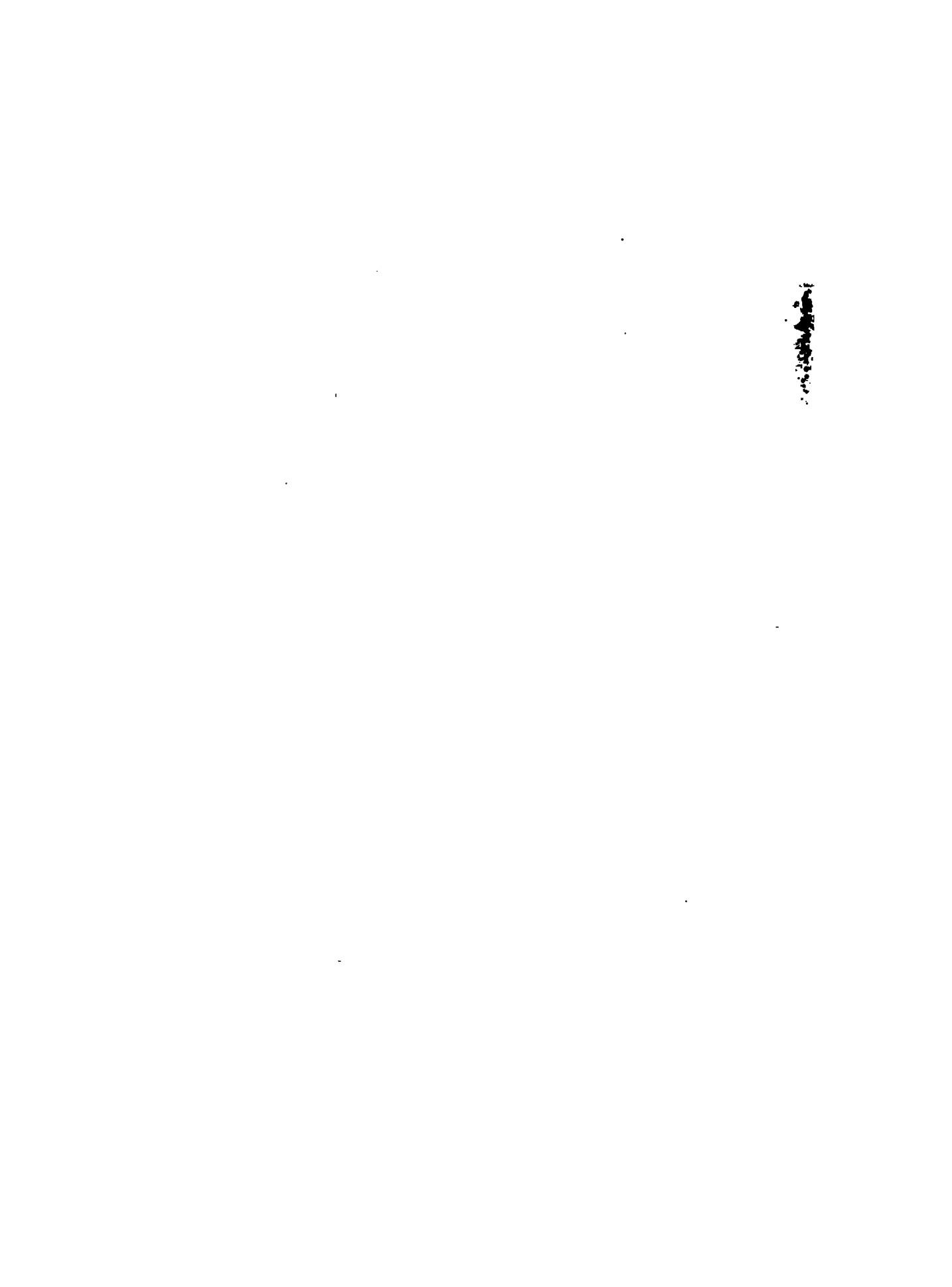


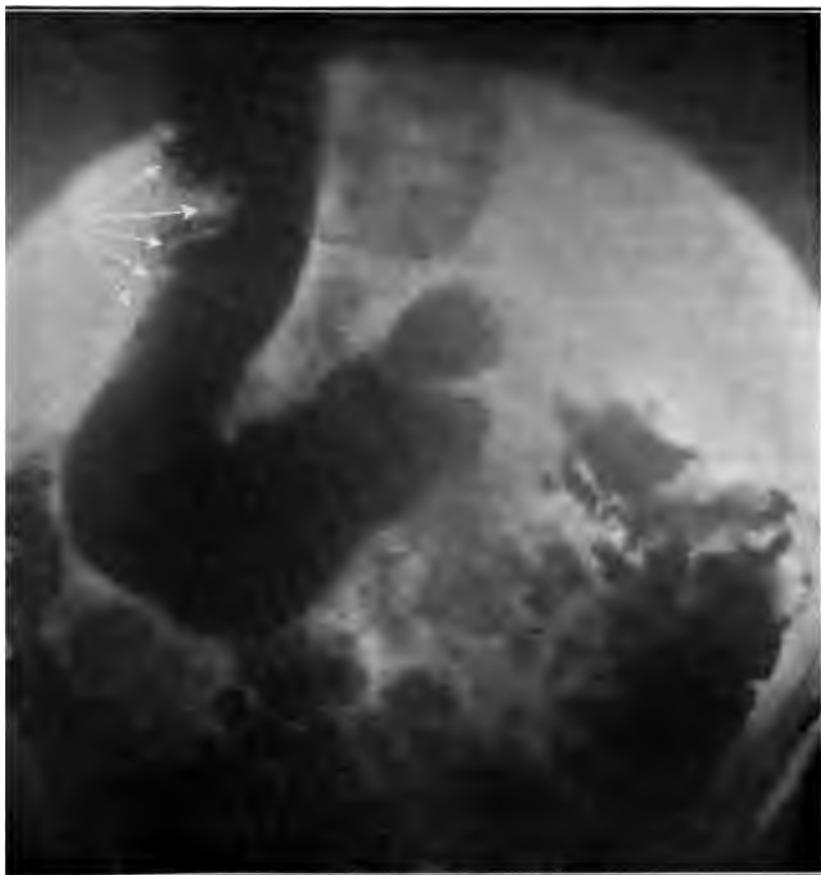
PLATE XXVII.



Malignant disease of the cardia. Arrow points to mass. (Made in  
the author's X-ray department.)



PLATE XXVIII.



carcina near the fundic end of the stomach. Arrows pointing to neoplasm.  
Confirmed by operation. (Made in the author's X-ray department.)

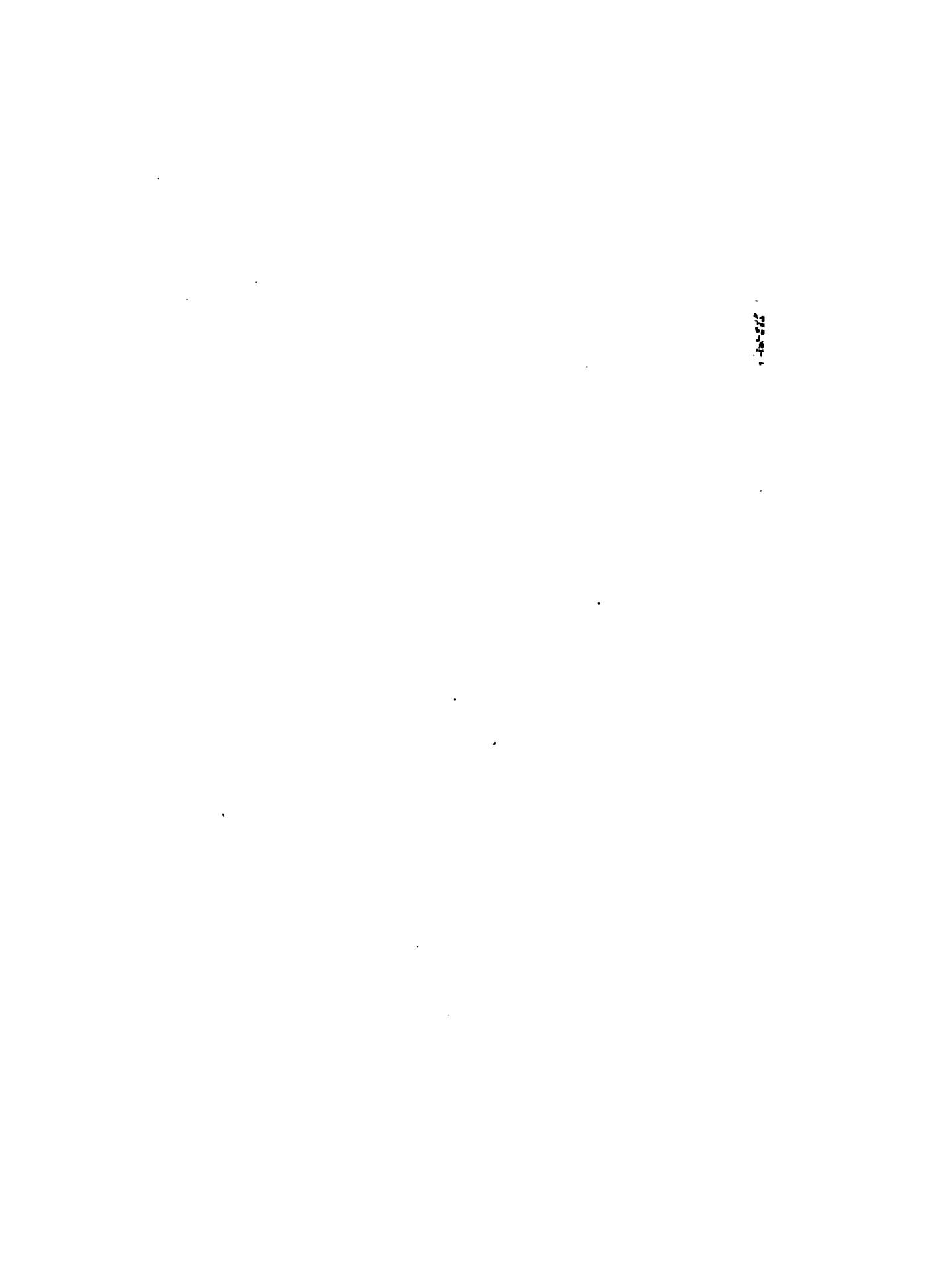
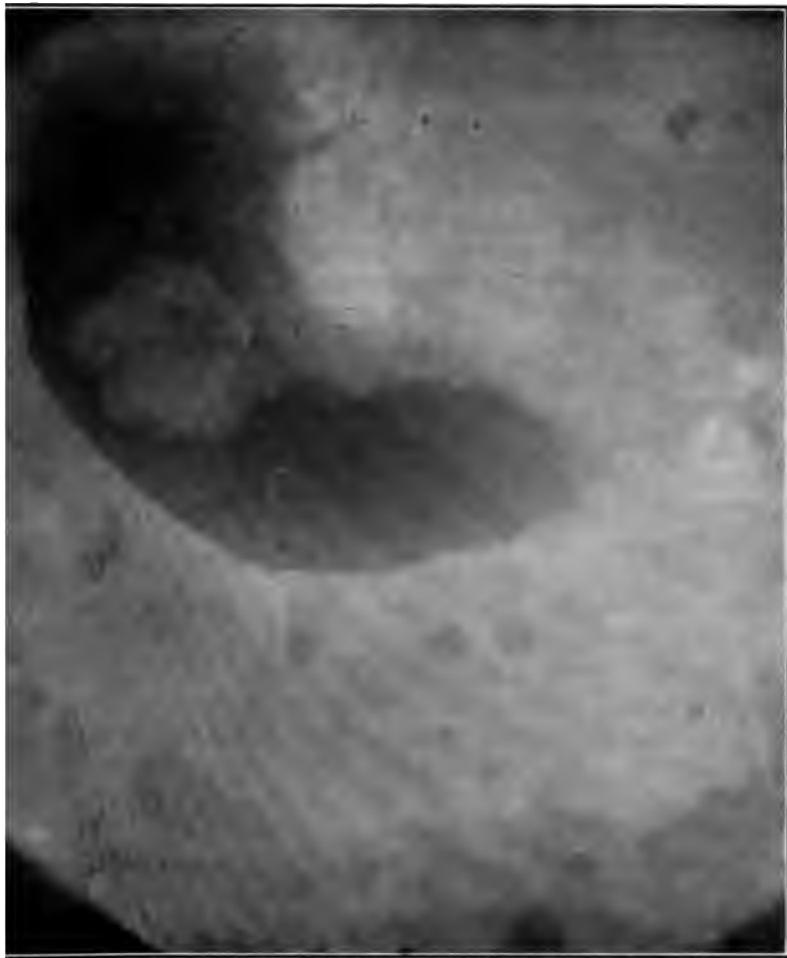


PLATE XXIX.



carcinoma of body of the stomach; also of lesser curvature in pyloric region. (Made in the author's X-ray department.)

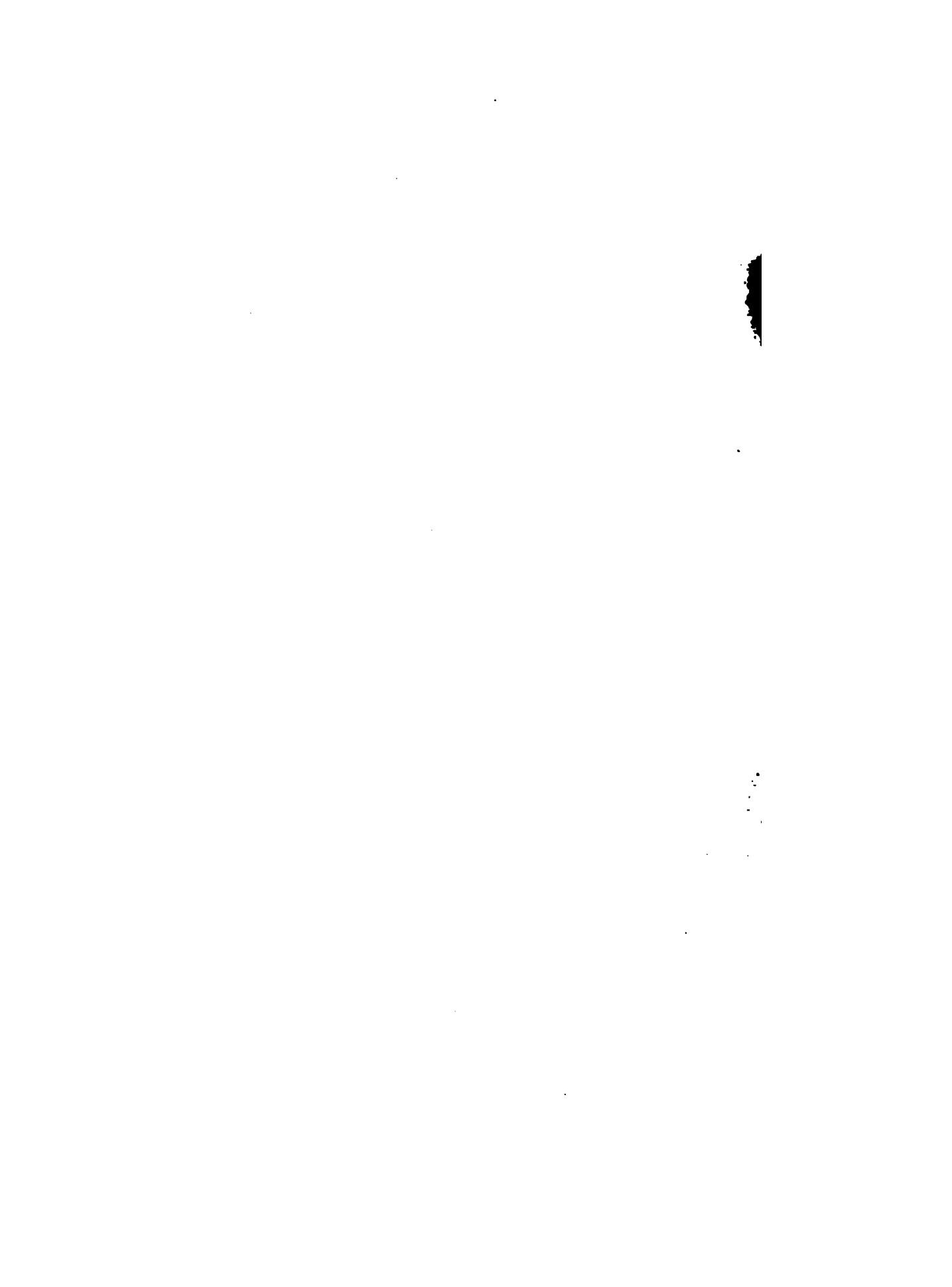
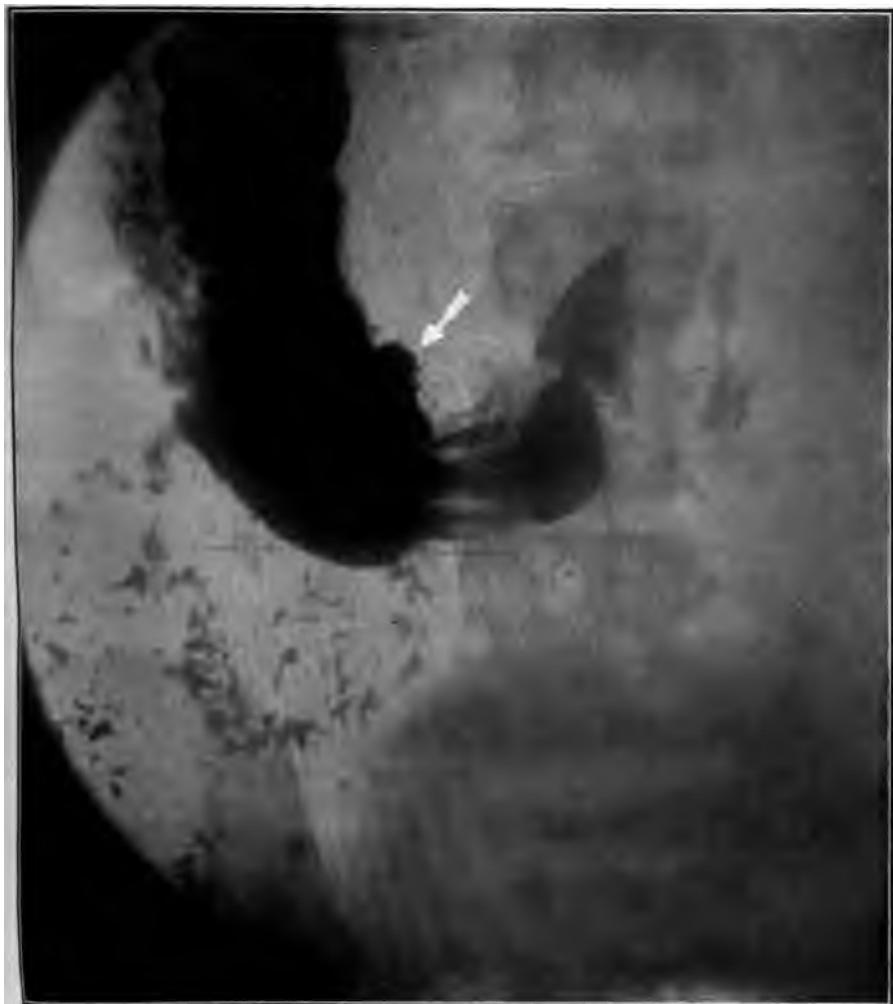


PLATE XXX.



**Small cancer on ulcer site on lesser curvature. Operation. Cure.  
(Made in the author's X-ray department.)**

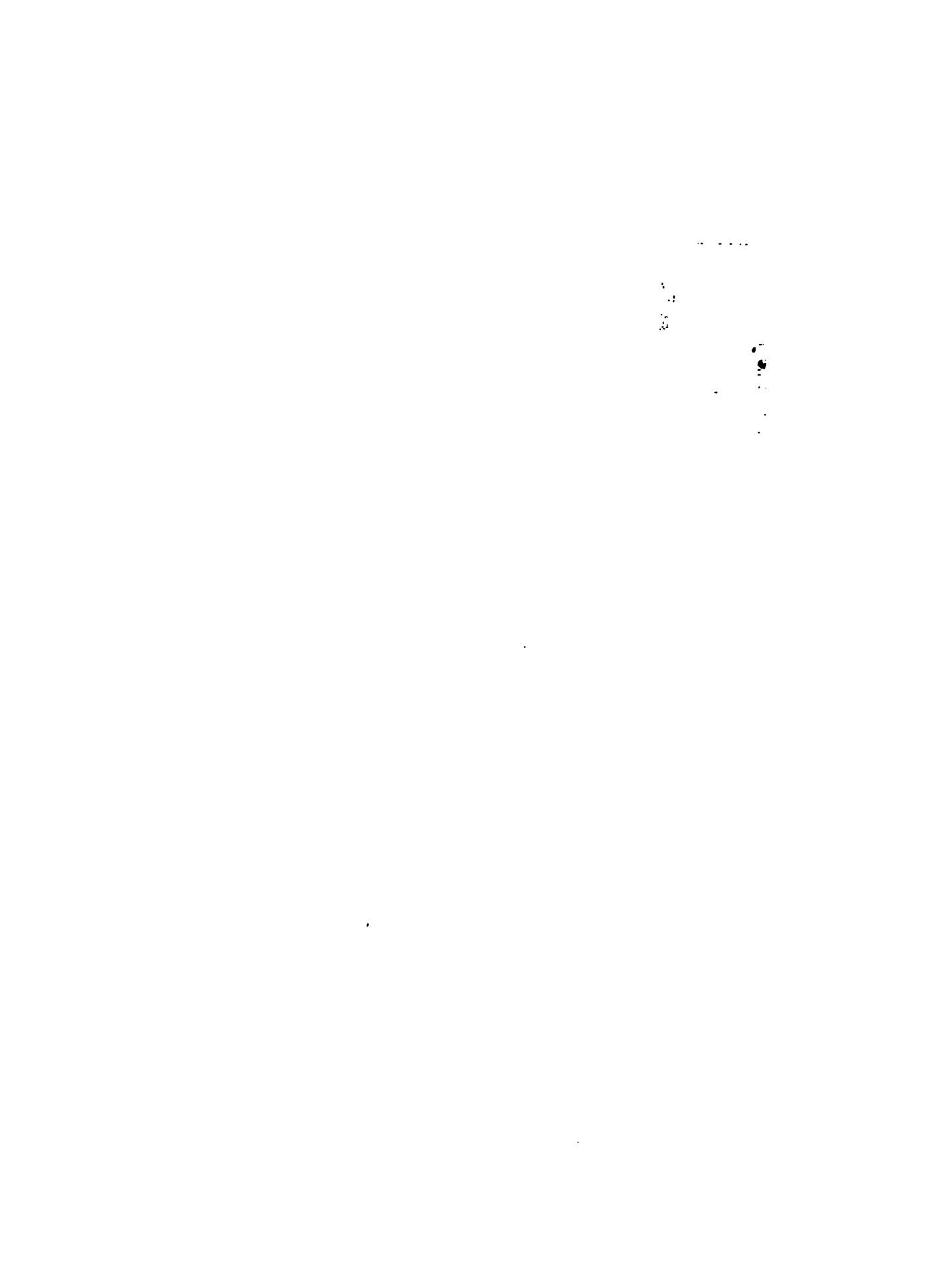


PLATE XXXI.



Early gastric carcinoma, showing defect at pylorus, moderate dilatation of stomach, normal exiting. Arrow points to defect. (Made in the author's X-ray treatment.)



PLATE XXXII.



Carcinoma of the stomach, showing the advance of the growth at the lesser curvature and pylorus, the slight sacculation of the greater curvature below and metastatic growth above. The mass was directly under the liver, and the contraction of the neoplasm drew the stomach up close to it. Below the organ is seen bismuth in the small intestine. The mass was not palpable, although it is plain that the growth was advanced, which was confirmed by operation. (Made in the author's X-ray department.)



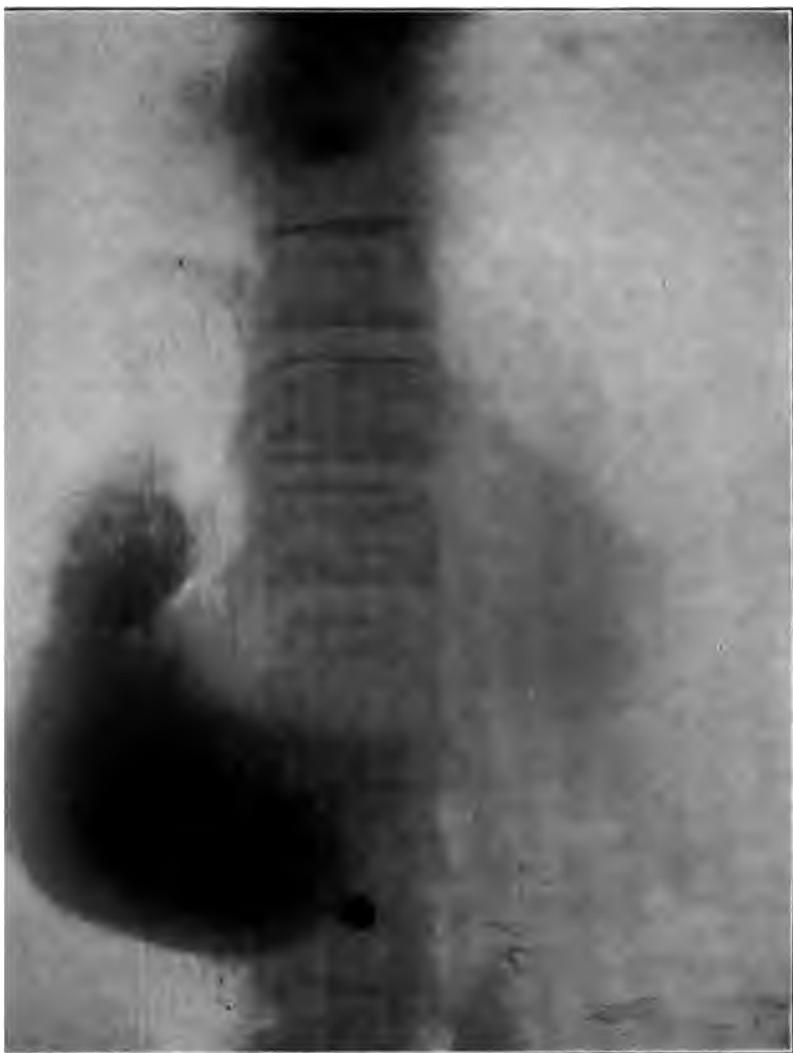
PLATE XXXIII.



Carcinoma of the stomach involving the lesser curvature without contractive drawing of the organ upward. Confirmed by operation. (Made in the author's X-ray department.)



PLATE XXXIV.



carcinoma of the stomach involving the lesser curvature, the irregularity  
the deformity of which was marked by the contraction and attachment of  
terior lying growth. The organ is considerably dilated, as can be noted by  
width of the pyloric region and size of the fundic end. Confirmed by opera-  
(Made in the author's X-ray department.)



PLATE XXXV.



arcinoma of the stomach. Tracing down the lesser curvature, the normal curve of the organ had been preserved to in front of the spine, where the enlargement upon the organ is noted. It will be noted that the upper part of the pyloric region, the pylorus, and the first part of the duodenum are involved in a mass which begins about half-way down the stomach posteriorly (seen in the dark area above the lesser curvature). The entire organ is somewhat small and retracted upward, and was not stagnant, although the pyloric region was markedly involved. (Made in the author's X-ray department.)

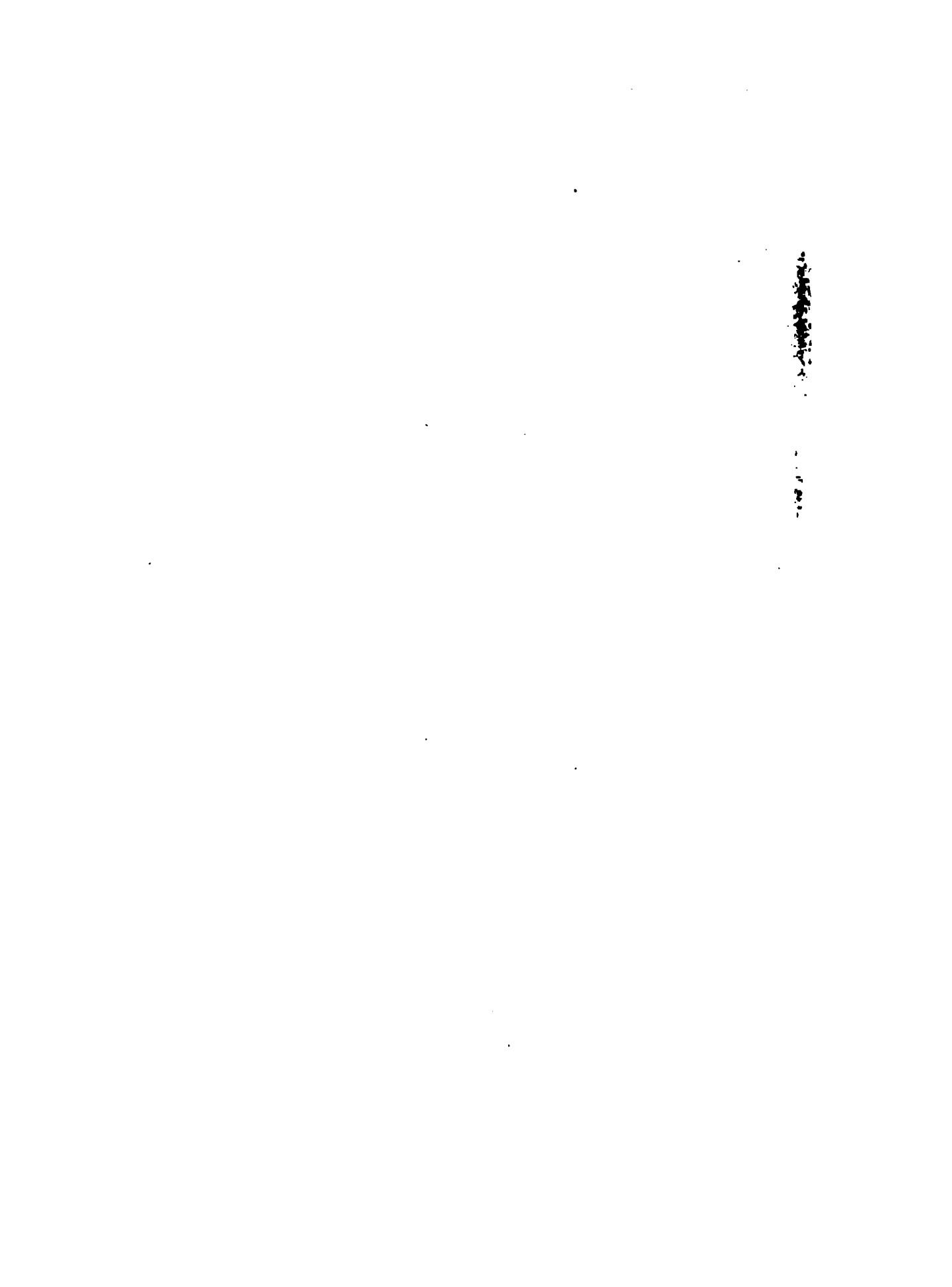


PLATE XXXVI.



Gastroparesis, showing the low position and dilatation of the lower portion of the organ, the attenuation of the stomach above this, the deformity of the latter due to gas collection at the splenic flexure of the colon pressing the latter curvature inward, and the pylorus in front of the line of the vertebra. (Made in the author's X-ray department.)

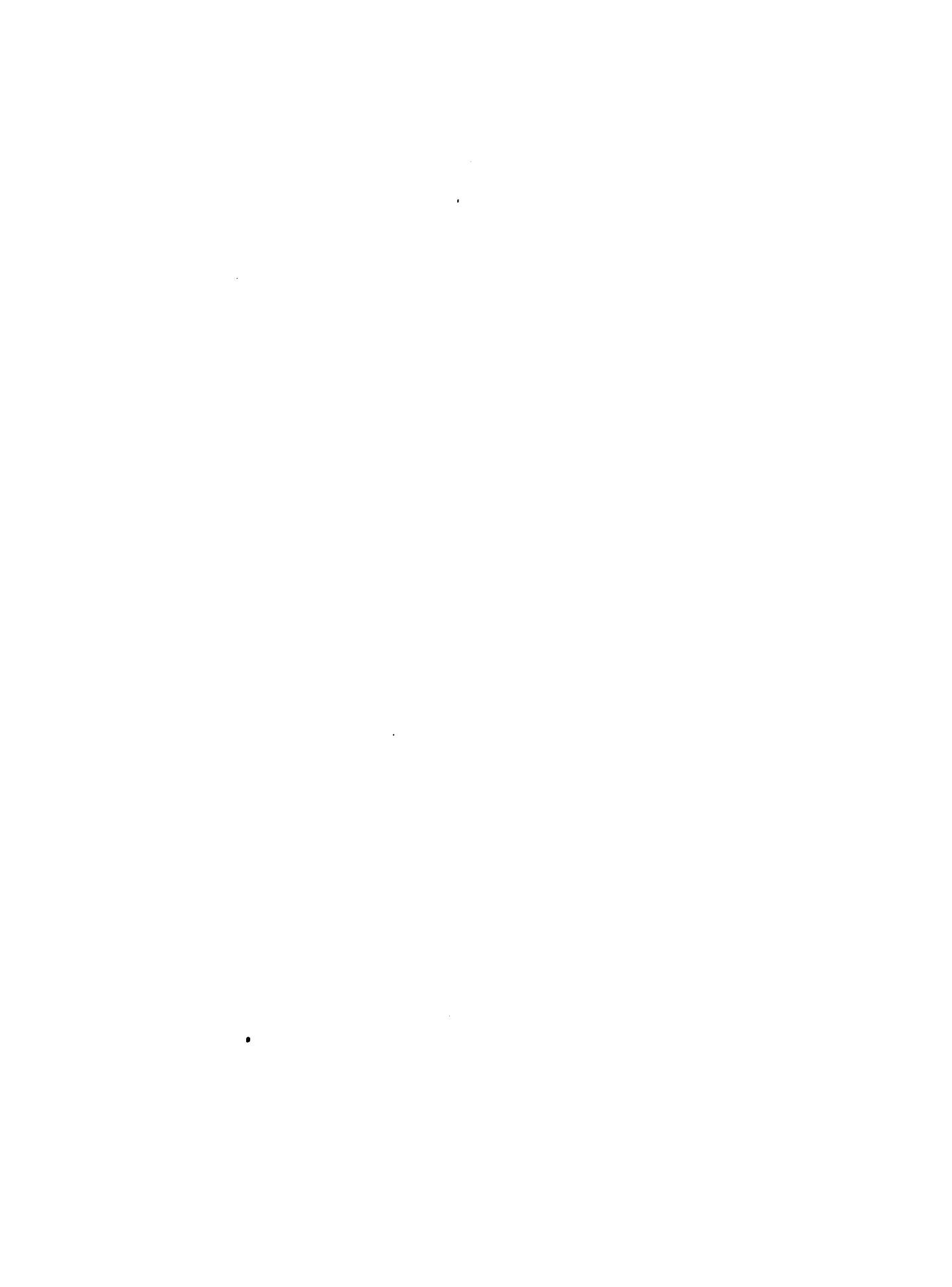
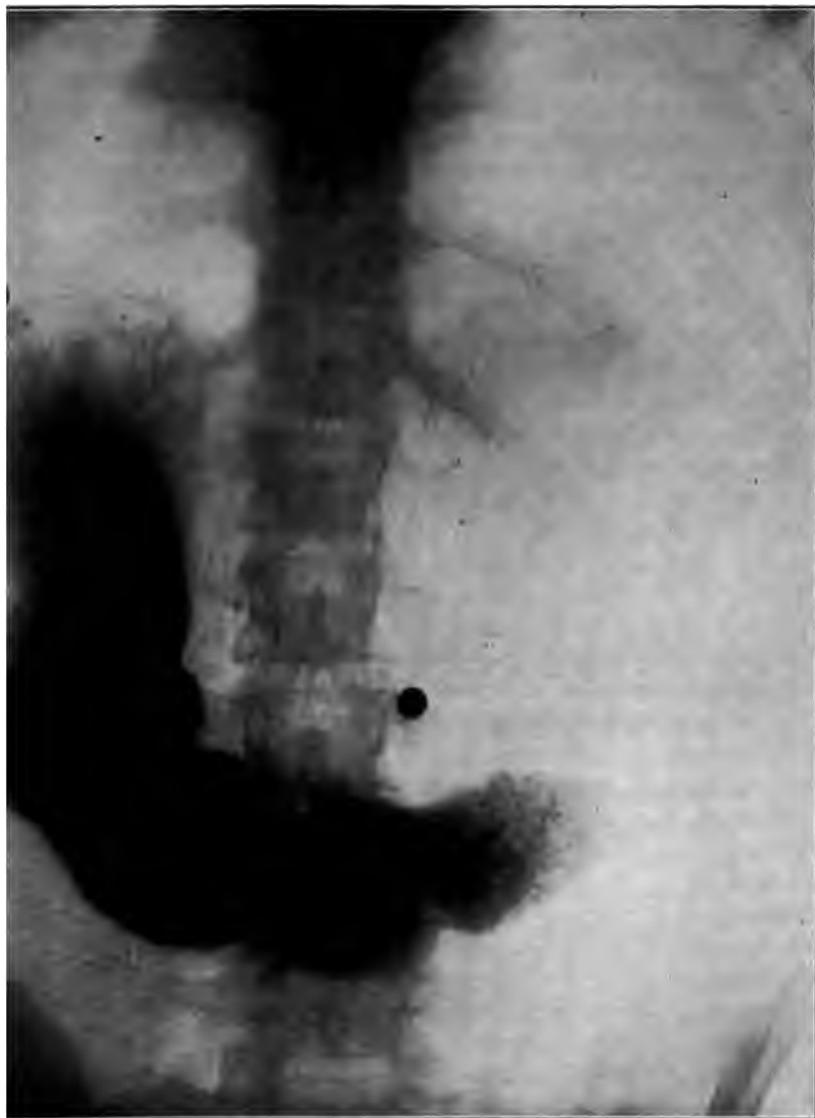


PLATE XXXVII.



Gastrophtosis, showing a long, attenuated stomach, markedly dilated in all directions. On a level slightly above the umbilicus will be seen grooves, one on each of the two curvatures, which mark the site at which the visible peristaltic waves begin in these stomachs. Below these are seen three peristaltic waves on their way to the pylorus, the first one showing a marked bulging of the greater curvature. (Made in the author's X-ray department.)



PLATE XXXVIII.



Gastroptosis, showing the low descent of the organ, a general dilatation of its lower portion, and the pylorus to the left of the umbilicus. The rotation forward of the stomach when food is taken into it is shown by the twist from before backward seen in the pylorus being posterior to the body of the organ. (Made in the author's X-ray department.)



PLATE XXXIX.



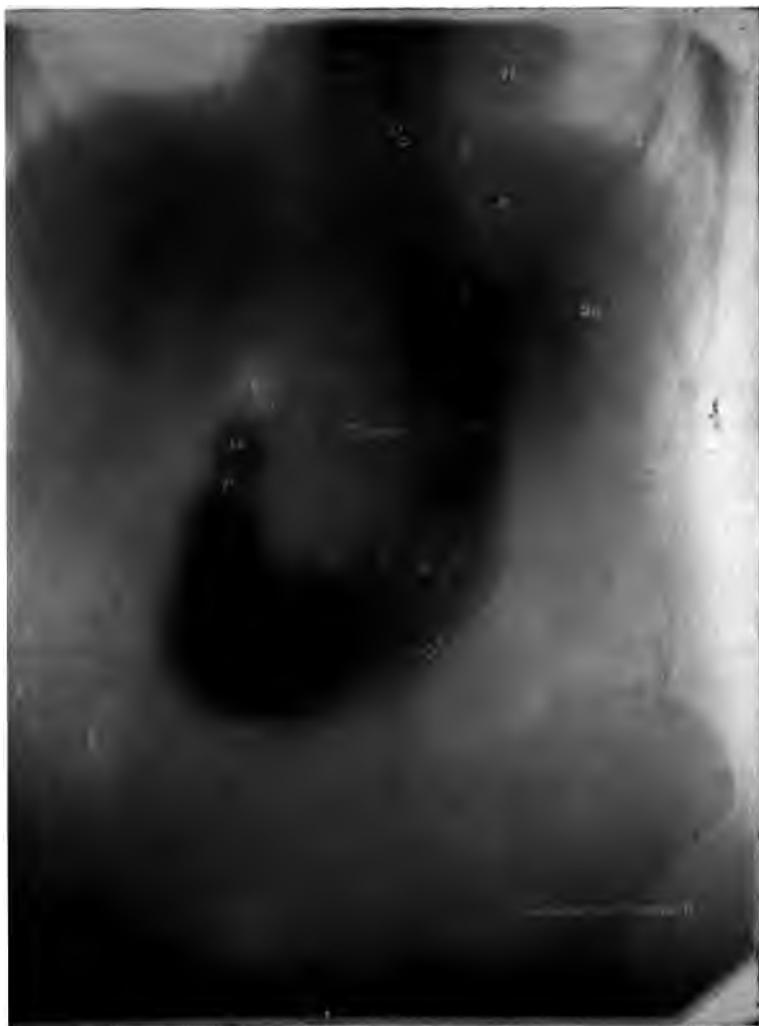
Gastrophtosis. Moderate degree of descent. (Made in the author's X-ray department.)



ptosis, showing greater degree of descent and relaxation than foregoing.  
(Made in the author's X-ray department.)



PLATE XL.



formed stomach by indentation from tumor. Outside of wall. *S, S, S*,  
*F, F*, Fundus. *Co*, Cardiac orifice. *Lc*, Lesser curvature. *Gc*,  
curvature. *P*, Pylorus. *D*, Duodenum. *g, g, g*, Gas. *H*, Heart. *Sp*,  
Stomach rugæ plainly shown. (*A. W. Crane*, Kalamazoo, Mich.)



PLATE XLI.



Swelled gall-bladder, pressing on pyloric end of the stomach. Confirmed by operation. (Made in the author's X-ray department.)

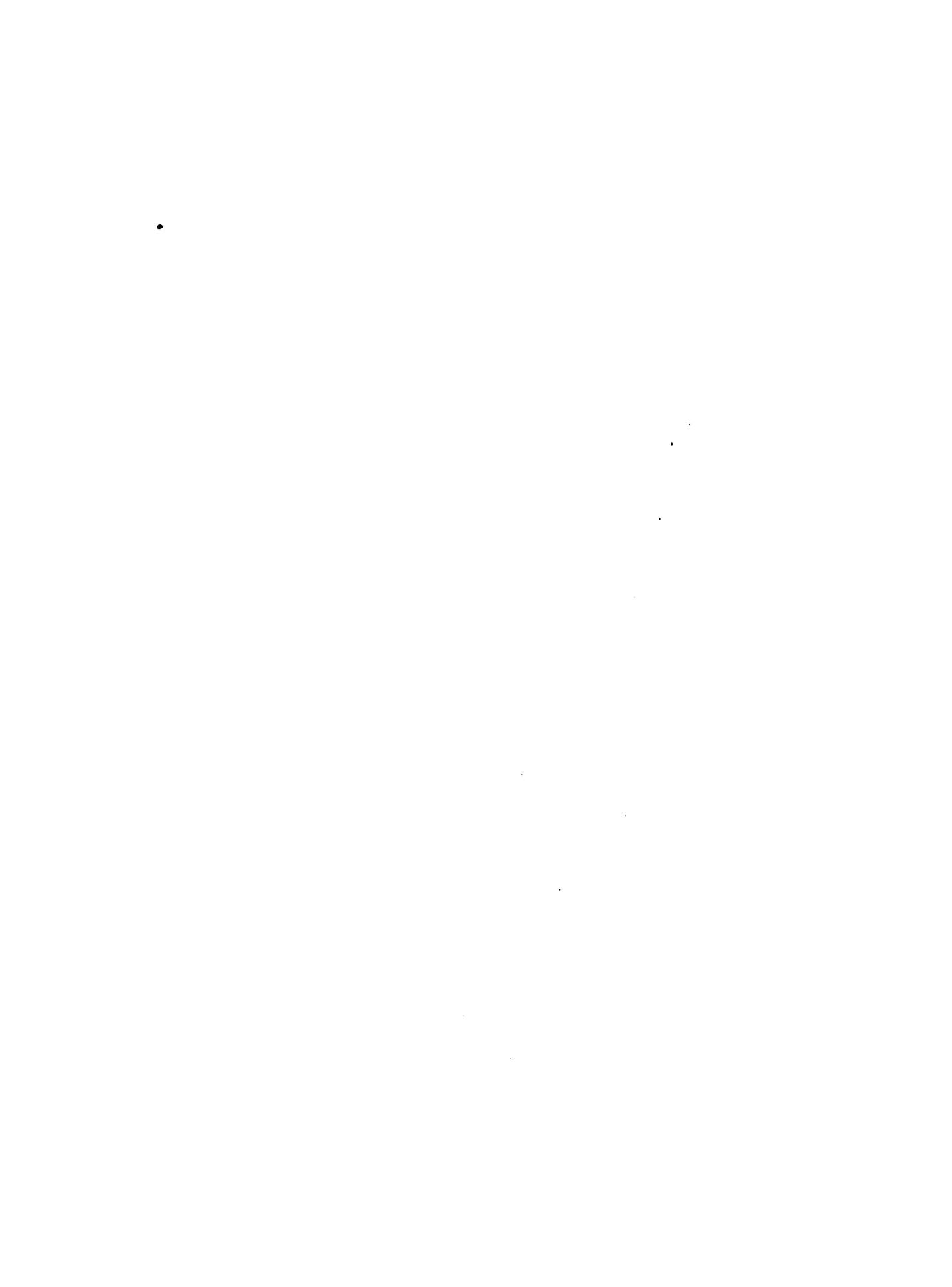
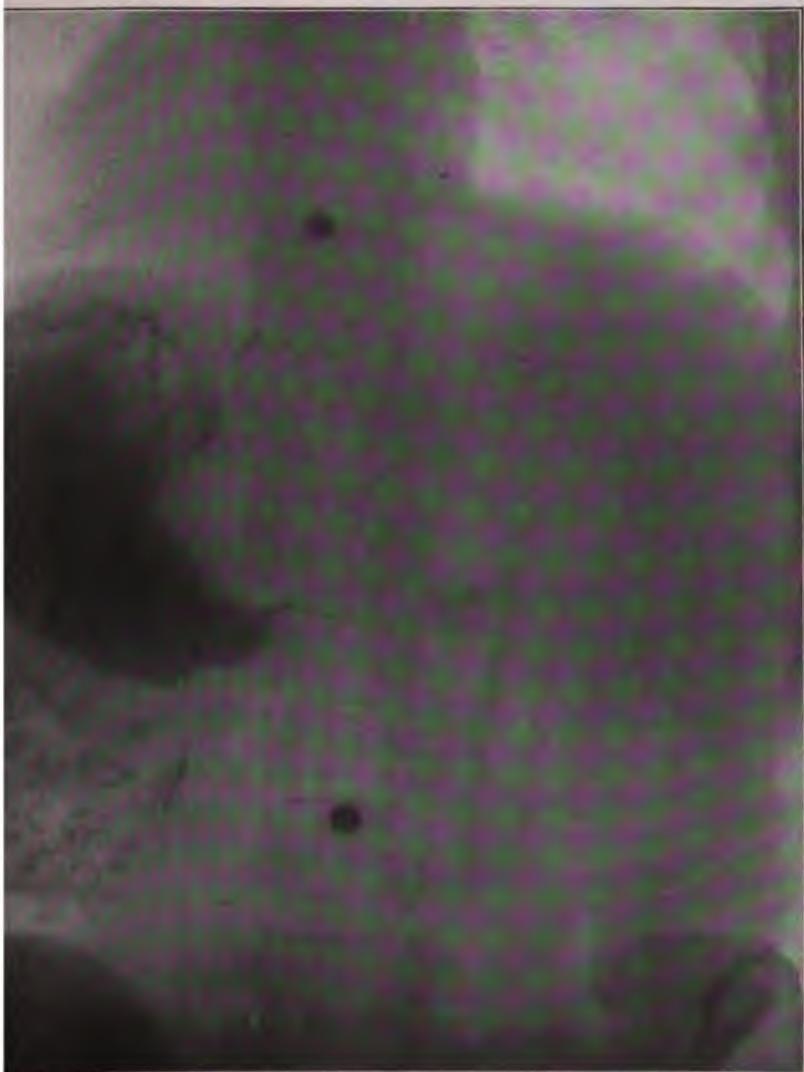


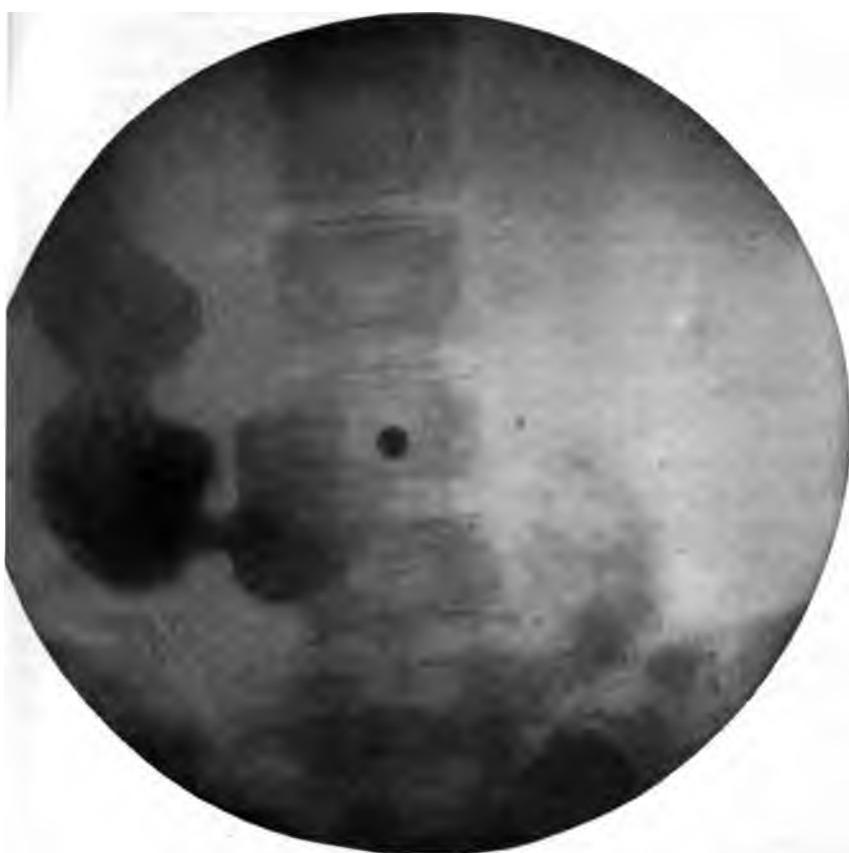
PLATE XLII.



case of hypertrophic gastritis with stenosis of the pylorus. Note the small size of the stomach due to cirrhotic change in the walls, the pyramidal shape, the apex at the pylorus, which is some distance to the left of the vertebral column, instead of to the right, as it is normally. The removed pylorus is shown on page 560. (Made in the author's X-ray department.)



PLATE XI.III.



Stomach in a case of neurotic hypermotility, showing the ampullar phases of the stomach motility. In this instance three such ampullæ are seen, but as many as six have been observed, ranging all the way from the fundic end to the pylorus. The course ascribed by the normal duodenum is plainly shown. (Made in the author's X-ray department.)



some time in the course of the canal or at the cardia, the existence of a stenosis is suggested. Should a bismuth mixture be used, it passes quickly to the lower third of the gullet and here remains for a few seconds before the sausage-shaped mass disappears below. Should this large shadow continue to be observed at the cardia for ten seconds or longer, states of stenosis at that site would be suggested. In

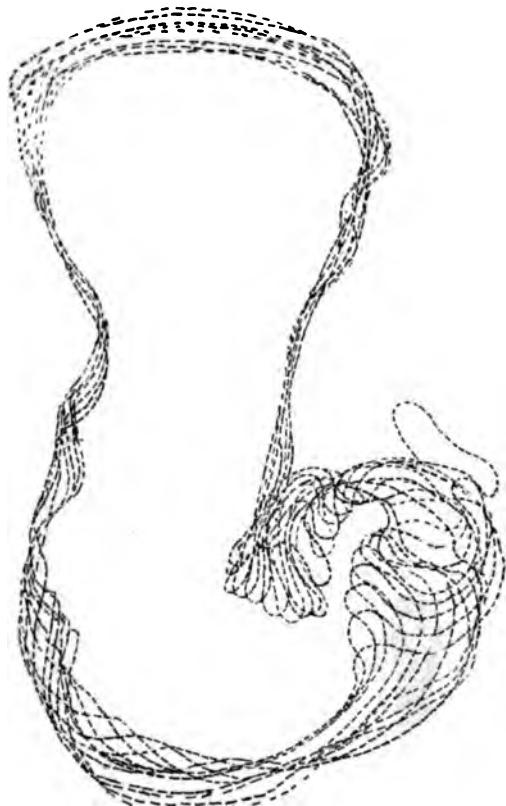


Fig. 25.—Typical peristaltic rhythm of the stomach (after Reider and Groedel).

instances where the bismuth capsules pass downward rather steadily but take over fifteen seconds to reach the stomach these may be cases of general thickening of the esophagus or affections involving the motor-power of the canal. By means of about an ounce or more free bismuth within the stomach, the position of the greater and lesser curvatures and pyloric region can readily be observed. By employing about double the above quantity of bismuth the position and shape of the transverse colon can often be directly observed twenty-four hours after its ingestion, or, when only the colon is to be outlined, it is a better way to give the bis-

muth emulsion as an enema in the left position with the hips slight raised and waiting an hour before making the observation or exposure for a negative. A colon tube is not necessary to deliver the emulsion high in the bowel because in ten to forty minutes after the injection, even when a short tube is used and providing the lower bowel is clear of accumulations,

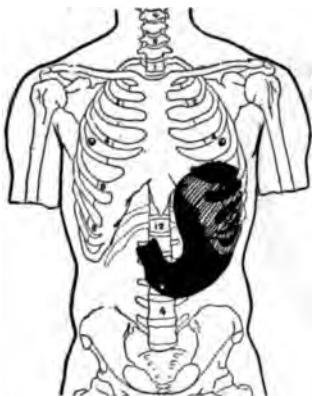


Fig. 1.

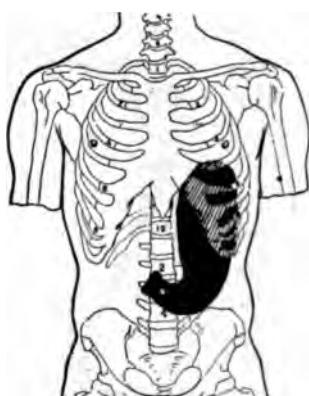


Fig. 2.

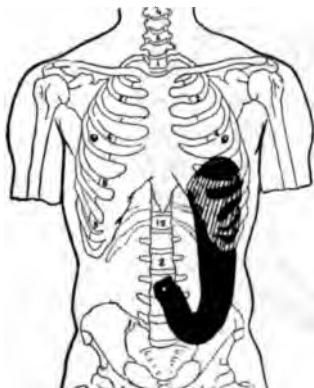


Fig. 3.



Fig. 4.

**Fig. 26.—Degrees and types of gastrophtosis compiled from 89 roentgenographs in the author's possession. The white dot represents the location of the umbilicus:**

**Fig. 1. Moderate degree of descent. Fig. 2. More advanced condition than the above. (Some dilatation.) Fig. 3. Extreme degree of ptosis. (Vertical stomach.) Fig. 4. An uncommon picture of a type of gastrophtosis accompanied with an extreme degree of dilatation.**

lated feces, the bismuth by antiperistalsis will be found to have reached the hepatic flexure. Another method is to give about 90 grams of bismuth subcarbonate about twenty-four hours before the exposure is made, the first outlining the colon and the second the stomach on the same plate.

By means of the fluoroscope, the presence of metallic articles of some size may be observed in the alimentary canal. No bismuth, of course, should be employed.

While much has been written on the subject of fluoroscopy suggesting that this method alone should be used for diagnostic purposes of esophagus, stomach and intestinal conditions, I confess to my limitations with it. With even the most efficient and up-to-date apparatus, some points of detail cannot be observed with the eye looking upon a fluoroscopic screen as would be possible with an X-ray plate. There is a field of importance in which it is the best means, and that is the study of the peristalsis, such as has been mentioned with the bismuth capsules in the gullet, and the still more important stomach movements with the bismuth or barium suspensions and colon after a bismuth clysm. Argument has been presented that it is the only way by which the pyloric reflex can be studied for diagnostic purposes, which is refuted by many plates in my possession, one of which is Plate IV in this volume. In pyloric stenosis the plate method answers the best, although the observation of hyperperistalsis and stagnation in these cases is valuable. In gastric carcinoma, it has been claimed that by the fluoroscopic noting of irregular filling defects in the outline of the stomach wall, and abnormal anti-peristalsis in the pyloric region, it is our best means of early diagnosis. I would hesitate very long before I would say that a jump-space in the peristalsis was always due to a local pathology at that point, not to go so far as saying it was due to a carcinoma or an ulcer. The pyloric region, where most of these lesions are found, is so deeply situated and far removed from the barium screen that one can never be sure of these in a short observation, and, furthermore, I have seen peristaltic jumps in perfectly normal stomachs, and others in which they are present at one time and not at another, or due simply to adhesions. To employ the method for diagnosing changes in the shape, size, position and contour of the stomach, means that the patient is exposed much longer to the rays than is necessary in the plate method; although it is my custom to always fluoroscope for a few seconds before making plates.

Because of the fact that important shadows are not possible of being observed, or if so too indistinctly by the eye, the use of the skiagraph method for making diagnoses is often to be preferred over the fluoroscope. By this means a permanent record containing much finer details of anatomy for leisurely interpretation is obtained. It is always best to make one's diagnosis from a negative rather than from a print of it, since in the latter some of the detail is invariably lost. By the photograph-plate method the best results are obtained of the size, shape, and position of the esophagus, stomach, and intes-

tines, as these may be important. Diagnoses of stenotic conditions: dynamic errors of the stomach, such as hypermotility, hypomotility or stagnation; the presence of calculi or metallic foreign substances in the abdominal organs, kidney conditions, and so on, are all possible of being reproduced in outline in negative picture upon a plate. I may be pardoned, in the light of my enthusiasm on this method of diagnosis, to again state that it is the most valuable single method of examination at our command, and that, while the proper kind of an X-ray outfit is somewhat expensive, and considerable time is consumed in doing this work, keeping the outfit in order, and developing the plates, nevertheless, from the fact that by it, it is possible for the internist to successfully make his own observations, the benefits are inestimable and well worth the while. Its use may be said to be as necessary in gastro-enterological work as is the employment of the ear in diagnosing heart and lung conditions.

#### SIGNIFICANCE OF GASTRIC MOTILITY (*Carman and Miller*).

Zone of Hypermotility .....	{ Hours	0	
		1 Early emptying, pathologic. (Nonobstructing gastric carcinoma. Duodenal ulcer. Diarrheic conditions.)	
Zone of Normal Motility.....	{ Hours	2 Normal emptying. (A normal stomach functioning in a normal manner.)	
		Early emptying, physiologic. (Hypertonic, steer-horn stomach.)	
		3 Early emptying, pathologic, but slight, or partially compensated. (Duodenal irritation. Duodenal ulcer with obstruction sufficient to prolong the evacuation time to two hours in spite of associated hyperperistalsis, hypertension and free pyloric patency.)	
		4 Disordered motility with abnormal but balanced factors. (Stenosing carcinoma with achalyia; average emptying time.)	
		Delayed emptying, physiologic. (Hypotonic fish-hook stomach.)	
		5 Delayed emptying, pathologic, but slight or partially compensated. (Slight stenosis. Stenosis with hyperperistalsis; evacuation retarded but within six hours.)	
		6 Delayed emptying, pathologic.	
		Stenosis.	
		7 (a) Organic. (Obstructing pyloric carcinoma. Pyloric ulcer. Obstructing duodenal ulcer. Periulcerous adhesions etc.)	
		(b) Spasmodic. (Reflex pylorospasm from ulcer on the lesser curvature cholecystitis, appendicitis, and remote abdominal lesions.)	
Zone of Hypomotility .....	8	Ftr.	

I would like to add a few words, however, on some of the dangers of error encountered. A negative which is taken immediately after an opaque mixture had been swallowed which shows scattered black patches produced by the barium or bismuth (which has been sent through the pylorus into the intestines) is not so liable to be suggestive of the existence of a relaxed pylorus as it is a hypermotility of the stomach. Peristaltic movements of the stomach induced by the presence of a poor bismuth mixture in the organ may give an irregular line to the stomach curvatures and radiations over the body of the organ closely resembling those produced by new growths involving the gastric walls. A notch seen at one of the curvatures of the stomach is not always due to organic states of constriction, or to the existence of perigastric adhesions—a skiagraph taken the next day may prove that it was only a hesitating peristaltic wave near the pylorus that produced this marking. Gastric and extra-gastric growths, unless of large size, may not show their presence on a plate. A colon loaded with barium and feces may sag (coloptosis), which if empty would be in better position. Plates of gall-stone cases may not show that stones are present in the gall-bladder—they may be too small, or contain too little calcium to cast a shadow or the subject be too obese. Two or more sets of plates made at different times but under the same conditions are essential in making most diagnoses. Like laboratory examinations, these observations are of most value in the positive findings—not in the negative. The employment of the X-rays is a measure of diagnosis along with history and older physical methods of examination to arrive at a diagnosis—not a means alone in every case.

**Apparatus, Preparation of Patient and Technique.**—The first requisites are a good generator and tube. These with their essentials should be located in a dark room, so that the eye can appreciate the shadows formed on the fluoroscopic screen. Coils for the purpose of fluoroscopic work should be built strong enough to stand the tension of a heavy charge of current, and be able to maintain this strong current for a few moments if needs be without danger to the insulations. Such good-quality coils are built by manufacturers in this country and throughout the world. In the matter of selection of an interrupter my experience has been that those attached to the coil and the Wehnelt form are much to be preferred to those containing a large quantity of fluid—such latter forms of interrupters offer too much resistance to the current for quick enough work for clearness. The mercury-jet form is best. A foot or hand switch to turn on and off the current as well as to control its rate of flow is a desirable adjuvant when an assistant is not at hand. Some apparatus to shut off all rays

from the tube excepting those which pass directly forward would be found to be of service; a lead-covered shield (which cuts off 99 per cent. of the rays) or case and a diaphragm apparatus answer for the purpose. The confusing soft rays from the tube may effectively be cut out by the interposition between the tube and patient of a square of  $\frac{1}{4}$ -inch wood, a plate of 2 mm. thickness of aluminum or a thickness of sole-leather. These, therefore, mitigate the danger of burning the patient in the long exposures necessary with a coil—since it is the soft rays that mostly affect the skin unfavorably and are liable to produce X-ray dermatitis and burns. The entire apparatus may be contained in a closet against the closed door of which the patient may stand during the observation and not see the tube when lit. Since many of the skiagraphs taken are in the upright position of the body, some contrivance is necessary to support the plate for the picture.

A new form of tube energizer, far more satisfactory than a coil, is used for X-ray work to-day. The apparatus consists in currents of a double motor, the one side run by the commercial current which generates on the other an alternating current which passes through a "step-up" to raise its voltage—with alternating currents a different form is used. The motor shaft also runs a contrivance which converts this alternating current into a unidirectional one which comes off the binding posts. This current is of such high voltage and free from inverse that from one-tenth- to one-second exposures are all that are necessary to make good radiographs through the abdomen. The advantage of this type of apparatus is apparent when one considers that the quicker the exposure the sharper are the stomach outlines, the less danger there is of burning the patient, and the easier it is on the tubes. With the best of coil and technique and when using about 40 ampères of current a good plate requires about ten seconds' exposure, while with the ordinary transformer this is much less. After a rather extensive experience with the different makes of transformers, I have come to the conclusion that for abdomen work one capable of delivering from the binding posts a current of 150,000 volts is necessary. With such a powerful generator, a time-switch for the exposure is absolutely necessary for the beginner, for in my work it is rare indeed that a longer exposure than a flash is made. For such "snapshot" exposures some experience is necessary.

Since the World War, a much smaller and just as efficient apparatus for abdominal work has been devised. It answers perfectly for fluoroscopic work, the component parts of which are practically identical with the older form excepting that X-ray tubes are fed by a common transformer.

As a final word on apparatus it is my present belief that separate fluoroscopic and separate radiographic apparatus makes for saving of time and convenience of work. Where large amounts of work are being done or even where much work is done in an individual case, it is better to have each apparatus set for the work intended to do and not to bother with adjustments of a single new three-way apparatus that is employed for two purposes.

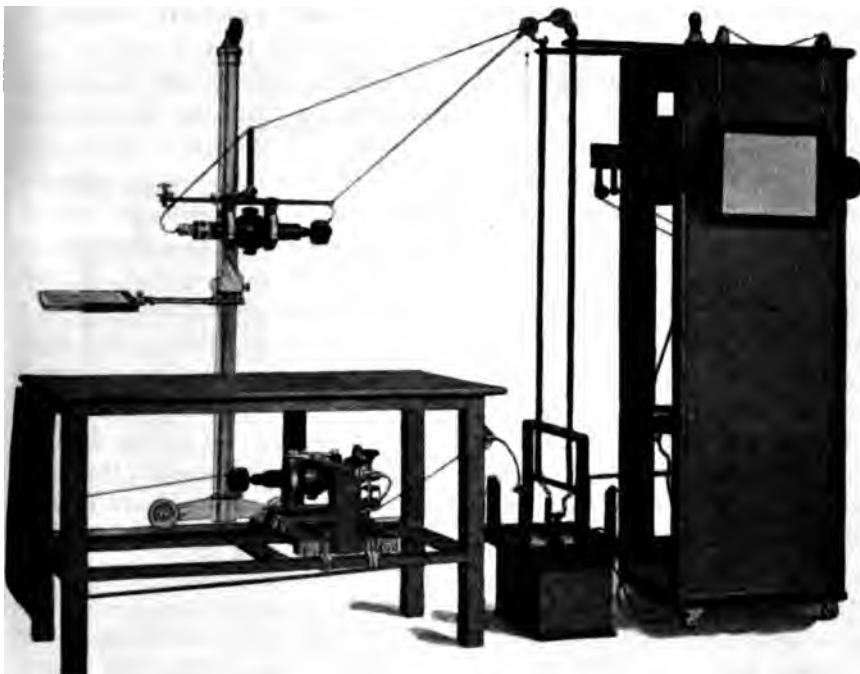


Fig. 27.—A practical and useful fluoroscopic and roentgenographic unit for general work (W & B).

It is the general custom with radiographers using this form of apparatus to employ the entire output of the machine exposing upon a plate inclosed in light-proof envelopes. While this answers the purpose fully, it is of advantage to use an intensifying-screen in abdomen work, although it is not absolutely necessary in the thorax exposures, as well as in all others. I work with no resistance in, the output being about 150,000 volts (this is generally figured as milliamperage of current by most men, which is not practical, because what we want is not the amount of current that a milliamperemeter records, but X-ray quality, and this cannot always be judged in that way). Manufacturers advertise that their generators are capable of deliver-

ing 150 milliamperes, which is of no practical value, considering that with a high resistance tube, this would fall to a low figure. An intensifying-screen is a surface coated with a preparation of tungstate of calcium, which becomes radioactive when exposed to the X-rays giving to it a light-blue color. This, when in contact with the sensitive film on a photograph plate, intensifies the effect upon the plate, or if still better two screens are employed with films, making possible much shorter exposures, a more practical degree of timing in the splitting of a second of time so that it will be just enough, and less exposure of the patient to the amount of X-rays. Such screens are supplied in card fashion so that they may be slid inside of the envelope containing a plate, but the better plan is to use those mounted in a plate holder, for this does away with the necessity of the paper-covered envelopes. With a coil, an intensifying-screen is most necessary, for by its use you can shorten the exposure to one-sixth of what would be necessary without it: not one-tenth, as has been claimed. These screens should be kept in a well-dried and lighted room; if not attached to a plate holder, in an envelope; should be handled with dry hands; cleaned with a camel's hair brush; the film of the plate should fit the screen surface tightly; and after two or three exposures, need not be exposed to the daylight, as some advise. Negatives made with the use of a screen have the image reversed to those made without it. This is because the exposure is made with the film side of the photograph plate downward; thus, my X-ray plates in this volume show the stomach on the left of the pictures, while in those made without it, it is on the right.

The proper tube to employ is one capable of withstanding a large amount of current (heavy anode), and low enough in vacuum to give fine points of detail. A hard tube answers best for bone work, but a soft one (just backing across a 2- or 3-inch spark gap) is the best for the soft tissues. With a large amount of current energizing such a tube, sufficient penetration is present to go through the body, and with the use of an intensifying-screen this vacuum in a tube can be kept quite regular. The proper size of a plate to employ is  $11 \times 14$  or  $14 \times 17$  inches; smaller sizes are not large enough to obtain a negative of the entire abdomen or chest of an adult, but may be used for the diaphragmed ones. The film must be of the fastest quality possible, of which there are now several brands on the market.

Recently a tube has been devised that marks a great improvement on the heavy tungsten-target forms. This so-called Coolidge tube possesses the practical advantages of accuracy of adjustment, stability of hardness, exact duplication of results, fixity of the focal point, long

, flexibility, tremendous output and absence of indirect rays. The vent of this tube has finally done away with "tube troubles" and makes it a stationary and dependable apparatus. It is particularly efficient for fluoroscopic work, and after a little experience, is perfect for plate work also. In the installing of an X-ray outfit the initial cost of this tube more than compensates for the outlay.

**Preparation of the Patient and Technique.**—The examinations are made with the stripped patient standing before the tube; with

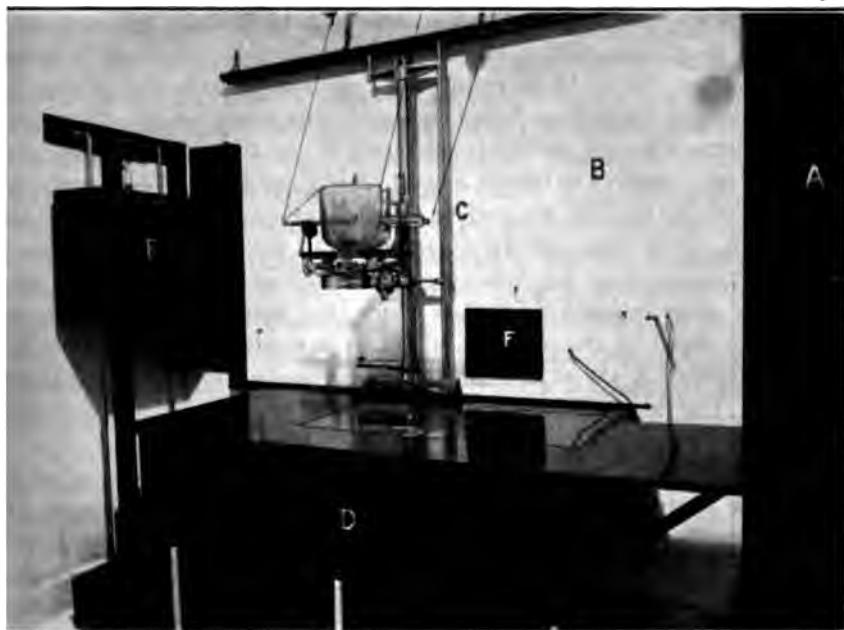


Fig. 28.—Section of author's X-ray room, showing a practical and suitable arrangement for indirect fluoroscopic and radiographic work. *A* is a doorway leading to behind lead-lined wall, *B*. *C*, solid upright holding tube, shield, and apparatus for stereoscopic work, this run on tracks above and below. *D*, table with fluoroscopic screens viewed from behind the lead-lined wall and having arrangements for plates. *E*, upright screen and plate-holder box. *F*, lead-glass window. The *A* is on a dumb-waiter door, this being used to serve plates from a room below, which serves as the developing and store room for plates and in which the transformer is placed, the control of which is worked from behind *B*. On the opposite side of the room is a vertical and horizontal fluoroscopic apparatus used only for this work. The indirect fluoroscopic observation is used only for centering organs on the X-ray films or plates.

women a light weight kimono may be worn at the time. In stomach work it is essential that the organ be empty of food, but in esophageal observations this is a matter of indifference. In abdomen

exposures it facilitates matters to have landmarks at the ensiform and umbilicus. For the purpose two small coins are employed fastened to the body by means of short strips of adhesive (not Z. O.) or court-plaster, but the situation of the umbilicus may be estimated as  $\frac{1}{2}$  inch above the level of the height of the crests of the ilia. The target of the tube for plate work should be about 24 inches from the plate, and be on a level with the part of the body examined; for the esophagus about opposite the sixth dorsal, for the stomach level with the navel, and for the intestines, gall-bladder, etc., the third lumbar vertebra. The tube should be transverse to the body and directly in back of the spinal column, excepting in gall-bladder work, when the right side should be exposed. The apparatus should be in prime working order before the X-rays are turned upon the patient, and the examination by means of the fluoroscope or to make a negative should be as short in duration as possible. Just how long an exposure to obtain a good plate should be, depends upon the thickness of the body of the patient, the amount of current employed, the penetration of the tube, and the sensitiveness of the plate. Less current is employed for fluoroscopic observations, which necessarily will be prolonged to some minutes. In plate work, the quicker the exposure the clearer the detail on the negative, although it should be remembered that an over-exposed X-ray plate is much to be preferred to one that is under-exposed. The developing of these plates is done by the usual methods of dry-plate photography.

In order to render the alimentary canal visible by means of the rays some material must be introduced which is either more or less opaque than the body soft tissues. As bismuth subcarbonate or subnitrate and barium sulphate (being metal salts) obstruct the rays and are harmless to the body (when they are of good quality and do not contain arsenic), they are used to block out the outline of the hollow viscera. Gas may be employed, either delivered directly into or generated in the tract by means of effervescent solutions, to differentiate the densities of the soft tissues; the latter is not so practical.

The ideal bismuth or barium food or mixture must have a known quantity of the salt, be quickly prepared, and easily taken. It is desirable to use a viscid vehicle so that the salt will remain in suspension for some time. For this, kefir, koumiss, zoolak, or an acacia or mondamin menstruum serves the purpose well, although its mixture in strained apple sauce or cereal pap may be used as a routine. For an adult, about 120 grams (4 oz.) of bismuth or 180 grams (6 oz.) barium is the proper amount to employ, and this quantity may be kept in separate packages so as to be handy and save time. When a fluid suspension is employed, it is sometimes wise to first give the patient something solid

to eat, like bread or roll, before the metal salt suspension is drunk. In this way, the metal is shut up in the stomach by the pyloric muscle and a better negative of the organ is obtained. As a routine, however, this is unwise because transit out of the stomach is important to note as is also the first part of the duodenum.

The routine method employed by me to-day is to have the patient take 6 ounces of barium sulphate in fermented milk six hours before the first observation. The examination is begun by fluoroscopy of the ileo-cecal region. Note is made of the "head" of the barium which should be in the proximal transverse colon; the amount of meal in the ileum is observed (ileal stasis) pressure is made on the appendix (chronic disease), size, shape and position of cecum and ascending colon, and the pressure of residue in the stomach (gastric stases for whatever reason). Six ounces more of barium is now taken, this being mixed in a tumbler with syrup of acacia or some fruit syrup and water. Stomach filling is observed, shape, size and position of the organ, pressure is made on various parts of the organ for tender areas, the pyloric function is observed, and the "cap" noted. Plates of both the ileo-cecal region and the stomach are then made, the number of plates being quite numerous. In 24 hours a plate or two is made of the appendix (retention then usually means disease), and the patient having had a preliminary enema to empty the colon is given a clysmal of 6 ounces of barium in acacia and water up to 2 pints. Its flowing in is observed by screen and then followed by a series of plates of that organ. At the time of the appendix observation (24 hours from first visit) plates are made of the gall-bladder, both kidneys, and perhaps some of the chest which should always be examined by fluoroscopy before the abdomen is looked at in the first instance.

In esophageal work it is better to use a condensed kefir or acacia-bismuth mixture, that can be drunk at the time of the observation or the taking of the picture. In obtaining a negative of the gullet, the patient, plate, and all should be in position, and when a number of swallows of the bismuth food had been taken the exposure made immediately. In stomach observations this haste is not desirable, and it is best to allow the patient to swallow the apple sauce or fluid mixture leisurely some minutes before the plate exposure, so that it can all be taken and to allow time for the barium to well coat the interior of the entire organ to the pyloric extremity; about ten minutes after being about right, of course during this time the fluoroscopic observations are made. To obtain pictures of the intestines time must be allowed for the bismuth to reach that part of the canal. Under normal conditions, in from six to twelve hours after ingestion, practically all of the barium in the small intestine is at the ileocecal valve, in from twelve

to fifteen hours in the ascending colon, in the transverse colon about twenty-four hours, and in the sigmoid and rectum in thirty-six hours. A negative of the stomach can be made on or and without giving more bismuth a good picture of the colon usually be taken on the next at the same hour. When just the outline of the colon is desired, some fluid forms of bismuth or barium may be introduced by enema as was mentioned before.

Fluoroscopy should be followed by the taking of many plates, for the best sort of diagnostic work should be by the "serial radiograms" as suggested by Cole, which holds especially true in the pyloric region, the stomach and the first part of the duodenum. Most minute lesions are possible of diagnosis this way and by no other.

Another method for rendering the esophagus visible is that of Cope and Stewart. In this, a section of hog casing is selected about 40 cm. in length—it must be tested with water before using to be sure that no bad leaks are present—one end is tied firmly with some dental floss and is then tested to see that this end is absolutely closed. There will, however, be considerable oozing through the membrane in all sections; this is not a disadvantage as the oozing may fill up sacculations or depressions in the esophageal wall which the casing itself does not reach. After lubricating the casing the first procedure is to attempt to have the patient swallow this down to or through the obstruction. Many patients, despite peculiar contortions and swallowing efforts are able to force this slippery tube through the contracted lumen, which result is most gratifying to the operator as well as the patient.

In cases, however, in which a stricture is very tight and the patient themselves are unable to pass it on beyond the obstruction, we must resort to artificial means of introduction, preferably by means of a French catheter. This catheter is inserted within the casing after having been lubricated with an emulsion of Irish moss; catheter and casing are now introduced into the esophagus. After having pushed the casing through the obstruction and well beyond, the catheter can be deftly removed by quick withdrawal. There are cases, however, in which the stricture is so tight that an attempt to withdraw the catheter also removes the casing; in these patients, one can employ a rubber tubing about 30 cm. long, with a hollow metal tip at the lower end and a metal junction at the upper end, to which is attached another piece of rubber tubing about 18 cm. long. The lower tube is fenestrated at frequent points. This lower section is passed into a piece of hog casing previously tested and found satisfactory, and tied firmly below to the metal tip and above to the metal junction, after which it is again tested with water to see if any leaks are present. Into this rubber tubing is placed a metal intravenous





ich the same as in a styletted catheter. The introducer, however, could be well lubricated before the attempt at introduction is made. The patient is then placed in the sitting posture with the head well back. Using the first finger of the left hand as a guide, as far into the larynx possible, the tubing is directed downward into the esophagus and used a sufficient distance to feel confident that the lower metal tip lies thin the stomach. Then with a quick upward motion the introducer can be safely removed. We now have the hog casing within the esophagus inclosing a rubber, fenestrated tube. It is only necessary now to inject sufficient of the bismuth solution to balloon out the casing. We are usually about able to tell when this has been accomplished by the symptoms of the patient, who immediately complains of a feeling of distress along the line of the sternum, with dyspnea; it is in these cases that oretone acts so well. As a precautionary measure, however, it may necessary to measure the capacity of your casing before the injection, that the measured quantity introduced will give you an accurate idea the amount of dilatation of the tubing. Before the injection of the bismuth solution is commenced, the patient is placed on the table, in the posterior oblique position, with the plate beneath and the tube accurately adjusted above. Gravitation has been found the best method in ich to fill the tube. An ordinary salvarsan irrigator, attached to the outer section of the rubber tubing, is used, the bismuth solution being caused to pass in very slowly, aided by frequent swallowing efforts on part of the patient.

When the required quantity has passed in or the patient complains marked dyspnea, it is well to discontinue, placing a clamp on the rubber tubing. The plate should then be rapidly made. Considerable spasmodic movement is always present and persistency of defect is quite as necessary esophageal work as of other portions of the gastro-intestinal tract, so it is often advisable to take two, three, or even more Roentgenograms fore each exposure, allowing a small amount of bismuth solution to ss in to compensate for the amount of oozing that occurs through the sing.

As a rule this procedure will be successful, although the amount of disturbance to the patient may be considerable at the first examination, which case it is best that for a day or two the patient's throat and pharynx be trained to the use of instruments, delaying the re-examination until such time as the introduction can be made with the minimum amount of disturbance. This method has been found most successful in regions below the sternal notch; above that point the strong pharyngeal muscles contract so actively that they do not allow, in many cases, the ballooning out of the casing; in consequence, most of the detail in that

locality is lost. From the sternal notch to the diaphragm, however, most accurate observations can be made.

This method is very successful in differentiating between diverticulum and carcinoma, one of the most puzzling problems to solve. The vital observation necessary in differentiation is the presence of the sacculation posterior and outside of the bismuth-filled hog casing lying within the esophagus.

The removal of the casing or the tube in the casing after the examination is completed is not difficult. Usually a little gentle traction aided by some gagging efforts on the part of the patient with the body bent well forward will succeed. In some cases the patient may become frightened and make extreme efforts at removal, which induce a certain amount of spasm; in consequence, the traction on the casing is too great and it tears off at a level somewhere near the sternal notch. There is no danger in such an occurrence, as the bismuth solution is thin and in perfect emulsion and the casing digestible. Where the tube inside the casing has been used, the clamp on the inner tube is removed and the bismuth emulsion allowed to flow out. As soon as the caliber of the bismuth-distended casing is reduced sufficiently, it is easily slipped through the obstruction and removed.

Of late, however, in all esophageal work the thick barium-acacia mixture is employed. Six ounces of barium is mixed in about 4 ounces of syrup acacia or a cereal pap or apple sauce. This is drunk or swallowed and coats the esophagus well enough for all instances of pathology and diagnosis, and is much simpler and less distressing than the casing method.

It is desirable at times to obtain a perfect outline of the stomach and colon and note its size under moderate distention when a small quantity of tartaric acid and sodium bicarbonate separately in solution be given just before or after the bismuth mixture is swallowed; or better yet a half-teaspoonful of sodium bicarbonate may be mixed with the barium; in quick colon observations the intestine could be distended by means of a hand bulb. Should the barium mixture have been employed by enema, the distention by air should be delayed until immediately before the picture is taken (some time after the bismuth enema was given).

It must be remembered, that, the less barium or bismuth a suspension contains, the more sharply is the cardiac end of the stomach defined and the rugæ noted. The more the solution contains, the nearer does the stomach approach a bag shape, because of its weight. The viscosity of the menstruum holding the barium influences the shape of the stomach far more than does the amount of barium contained in the organ, for when it is very fluid, the griping of the stomach on it and the

umber and height of the peristaltic waves are at a minimum. This can be taken advantage of in diagnosing some cases of healed gastric ulcer to show a cicatrix. For this, only a gram or two of bismuth is given in water with the patient lying first on the abdomen and then on the back. Plates taken under these conditions will often show the rugæ plainly, and a stellate cicatrix may be coated over and seen.

When a new growth of the stomach is to be outlined it may be desirable to take the picture with the patient lying on the left side (plate in front), or in the upright position with the tube at the right of the spine so that the rays can shine across the pyloric extremity from back to front and slightly to the left. It must always be remembered that the plate should be to the back or front of the patient according to location closest to the situation of the organ examined—therefore it is, that in stomach, colon and gall-stone work the plate should be at the front, and in kidney pictures at the back.

#### GASTROSCOPY AND ESOPHAGOSCOPY.

Over one hundred years ago (1807) Bozini directly examined the upper end of the esophagus, and from that day to this at various times with new forms of instruments, workers in medicine have brought this method of diagnosis into direct attention. While the employment of the endoscope had in former years but a very limited value in medicine, in recent times with the newer forms of instruments and more general understanding of their use and improvement in the technique of employment, its use to-day is worthy of practical consideration in diagnosing some of the esophageal and stomach conditions which come under observation. While any method by the means of which we may gain a direct view of the internal organs will always hold a place of importance in diagnosis, endoscopy of the esophagus and stomach or the upper respiratory tract will always have a limited application in medicine mainly because of the distress incident to these examinations. Added to this is an element of danger in the passage of this instrument unless done by one who has had sufficient experience with it, and the fact that, in so far as stomach work is concerned, its diagnostic advantages are modified because all of the interior of the stomach cannot be explored and that the endoscopic fields observed are not always distinct enough for definite diagnosis. Still, any physician, after a little study and practice, can use this instrument with most signal help in a few of his cases.

The instruments used may be divided into the older ones through which the illumination had to be thrown down the tube from the

outside (Mikulicz, Rosenheim, Kelling) and the recent ones which have a "cold lamp" on the distal end of the tube near the area explored (Einhorn, Jackson). In 1906 Jackson improved upon the Einhorn instrument (which was an esophagoscope), and advanced an instrument by means of which the interior of the stomach could be explored—by having a longer tube than the esophagoscope—and containing an auxiliary tube to be used for drainage and suction of the secretions.

Together with this instrument, which is obtainable in various lengths for either esophageal or gastric work, he devised a number of long-shafted accessories, such as cotton or gauze carriers for mopping secretions, forceps for the removal of foreign bodies and obtaining portions of tumors, and so on. Altogether, Jackson's is the most satisfactory form of instrument to employ.

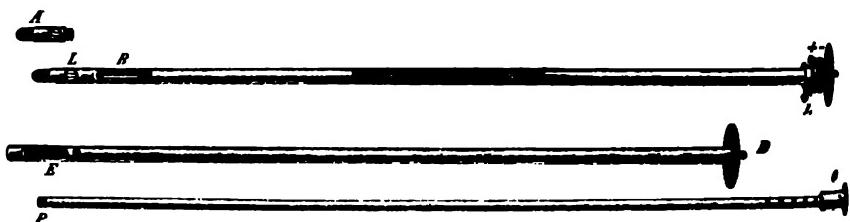
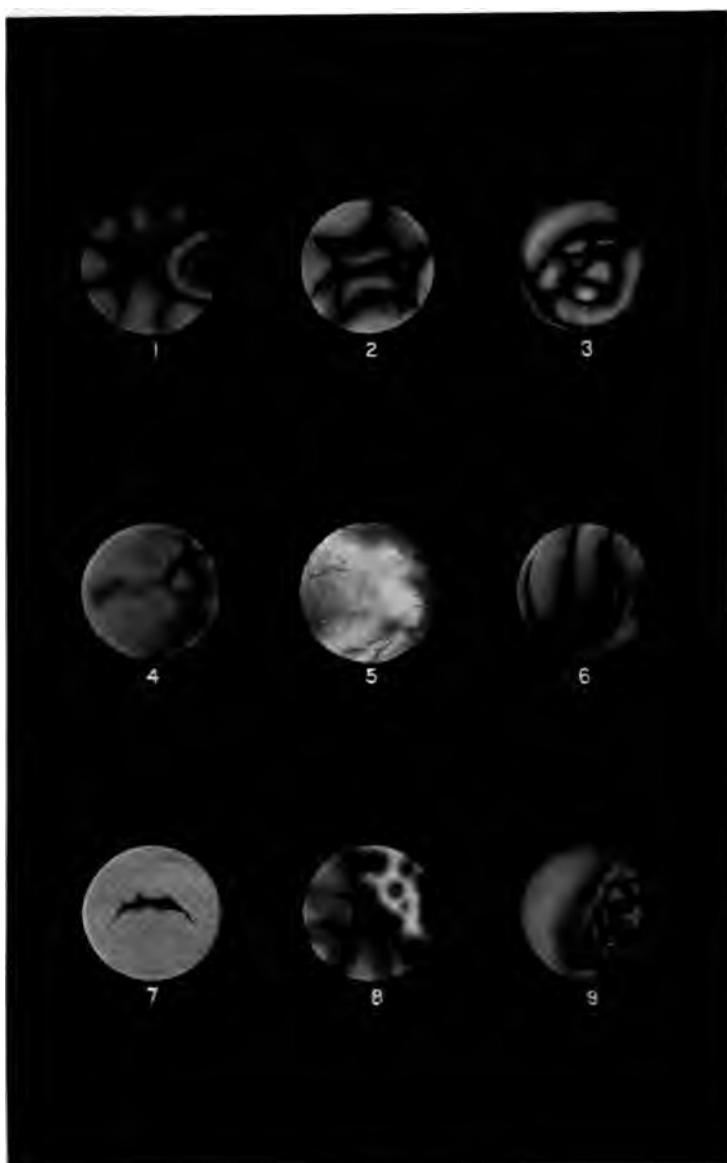


Fig. 29.—Rosenheim's gastroscope.

This observer (Jackson<sup>10</sup>), who has made such marked advances in the use of the instrument, may be quoted in his beliefs as follows: "The explorable area varies in the normal adult stomach from one-half to three-quarters of the total mucous membrane, the field being considerably larger in infancy, dilatation, or prolapse. Careful attention to two points eliminates most of the difficulties in gastroscopy; the first of these is that profound anesthesia is essential (in the esophagus the use of cocaine is preferred) since when the tube enters the stomach straining and retching are uncontrollable, annoying, and dangerous; the second point is the position of the patient, the most favorable one being that in which the mouth, pharynx and esophagus are brought into a straight line. To accomplish this the patient is drawn forward until the tops of his shoulders clear the table by from four to six inches, and the mouth gag is inserted on the left side. The assistant is placed at the right side of the patient's head on a stool of appropriate height, as though on a side saddle, his right leg beneath him in the kneeling position, his left foot supported on a stool twenty-six inches lower than the top of the table. His right forearm is passed under the

PLATE XLV.



Gastroscopic Views. (*Jackson.*)

- 1, Normal stomach. Three centimeters below the cardia. 2, View near the pylorus. 3, Same location, same patient. 4, Chronic gastritis. 5, Cicatrix in stomach. 6, Stomach ulcer on left side of right fold in view. 7, Cicatrix of perforated gastric ulcer. 8, Carcinoma of pylorus. 9, Carcinoma of pylorus.



atient's neck, supporting it; his right hand grasps the mouth gag, rawing it strongly at or in front of the bregma, bending it backward and exerting a certain degree of upward pressure. The foregoing points having received attention, certain difficulties remain. They are, however, altogether above or opposite the cricoid cartilage and are surmountable with slight practice. Mikulicz determined one point, namely, that a gastroscope must be rigid. Rosenheim went a step further and said that it must not only be rigid but should be straight; now think we are ready to add four more dicta: 1. Optic apparatus must be abandoned. 2. The tube must be passed by sight. 3. The stomach must be examined in a collapsed state, to permit of mopping, palpation with the instrument, probing, and combined endoscopy and external palpation. 4. General anesthesia is indispensable to prevent

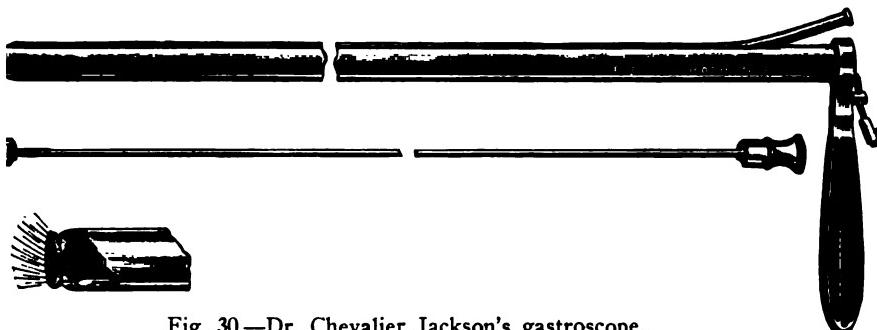


Fig. 30.—Dr. Chevalier Jackson's gastroscope.

contractions of the diaphragm which clamps the tube, rendering exploration impossible."

The instrument with the obturator *in situ* is dipped into warm water, or better still, thoroughly lubricated with glycerin. The esophagoscope may be introduced without the employment of a general anesthetic, although this is always preferable (the fear instilled in the patient from the looks of the instrument, and the distress incident to its passage makes a general anesthetic essential in most instances). Should it not be used, the patient sits on a backed chair with head thrown back and face toward the ceiling. The instrument is pushed into theullet without exerting any force and introduced the length of the esophagus. The obturator is then withdrawn, the lamp lit, and inspection begins and continues while the tube is being withdrawn. In stomach observations, it should be recalled that the commonest locations for pathological lesions—the pyloric and lesser curvature—are not accessible to vision through the tube, and that, even if nothing abnormal is noted in that part of the gastric mucosa which can be seen, serious

disease may still exist. Sternberg extols the superior advantages for both patient and physician when the patient takes the knee-elbow position on a table raised very high, the head extended over the edge of the table as far as possible. This combines the good points of the seated and dorsal positions without their discomfort and other drawbacks. It avoids danger of aspiration and of suffocation which are invited by esophagoscopy with the head hanging back. The secretions also flow out better, thus clearing the field for the esophagoscope. As there is so little discomfort or danger there is no need for haste, and no assistance is required. The esophagoscope slips in easily and the nose is left free as secretions cannot run into it. Both instruments should not be used except where a diagnosis cannot possibly be made by other methods, as

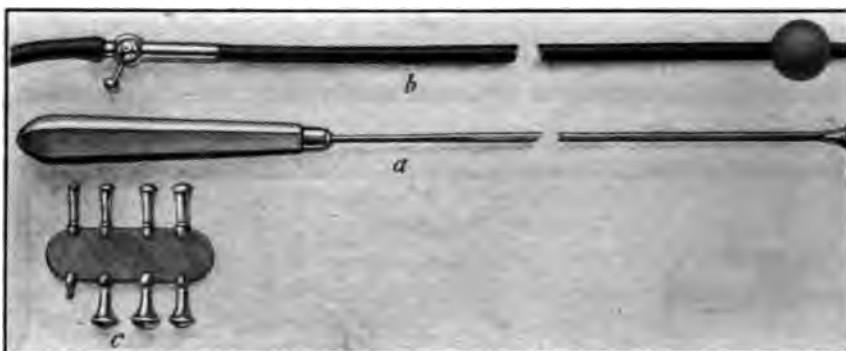


Fig. 31.—(a) Callmann's esophageal sound with mushroom tip. (b) Schreiber's esophageal sound for retrograde exploration. The collapsed bulb is filled with water after it has reached the stomach. (c) Interchangeable tips for Callmann's sound, representing sizes 15 to 36, French gauge, the increase being 3 millimeters each.

then only when, for existing reasons, it is important to make a diagnosis quickly. They should not be used in esophageal or gastric ulcer or phlegmonous gastritis, and it should be remembered that serious disease may tend to exist within the stomach wall itself, or immediately outside of that organ, in those areas the inspection of whose mucosa might give no indication of its presence. Its greatest field of usefulness is to make or confirm the diagnosis of malignant disease (carcinoma or sarcoma) in difficultly accessible portions of the esophagus or stomach, to remove foreign bodies from both organs, and to diagnose and possibly remove papillomata or polyps from the stomach. In my experience better results in examining the pyloric region are obtained in women than in men; this I believe is due to the fact that in women the vertical stomach is more commonly met with.

Since secretions in the esophagus and stomach are exceedingly difficult to remove through the tube and are disturbing factors in the value of the observations, the use of a full dose of morphine and atropine, or just atropine alone, should be administered hypodermically one or two hours before the observations are begun. A great disturbing factor in the use of these long tubes is the reflection of light in its interior; particularly is this troublesome in the proximal light instruments. When the lamp is at the distal end, the area of tissue seen is very bright in color and the nearby light in the tube throws a reflection so intense that the whole picture is of such brightness that one has some difficulty in keeping the vision centered on the tissue itself. For this reason, I have made a slight modification to the Jackson instrument I

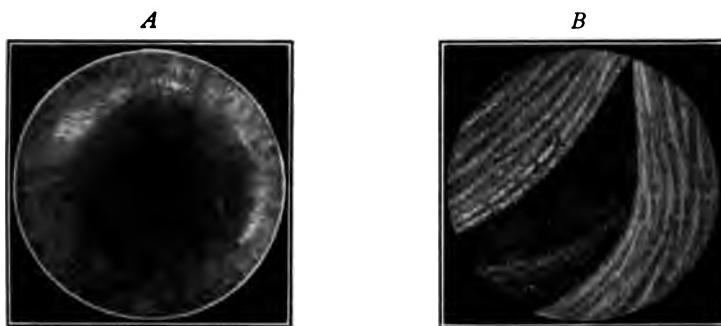


Fig. 32.—Cardiac sphincter—*A*, direct view; *B*, view toward the fundus or cardiac region—indirect.

employ, which consists of having the interior of the distal end oxidized or painted dull black for a distance of about 15 centimeters. By the existence of this zone a darker circle is seen about the tissue at the end opening, thereby separating this from the reflected light nearer to the eye.

#### ESOPHAGEAL BOUGIES.

Esophageal bougies are employed to note the presence and location of strictures of the gullet or cardia. In any case which gives a continued history of difficulty in swallowing (if this is not due to some faucial obstructive condition), where vomiting from the esophagus exists or when obstruction to the passage of the stomach tube has been met with, the use of the bougie may be necessary for diagnosis. Depending upon the degree of stricture or extent of growth, organic strictures (cicatricial) or malignant growths (cancer) render the gullet or cardia more or less impassable to the bougie olive. In spasmodic

conditions of a functional nature (esophageal spasm, cardiospasm), the olives are usually passed with ease or very little resistance, although sometimes a marked cardiospasm may be quite as impassable as a true stricture.

When *bona fide* stenosis exists, the various sized olives should be used, beginning with the one about the size of a stomach tube, and note should be made of the largest sized one that will pass into the stomach. The instrument should then be slowly withdrawn until the shoulder of the olive engages in the stricture; then the fingers are placed on the stem at the teeth (to mark the distance down) before the shoulder of the olive end disengages and the instrument is with-

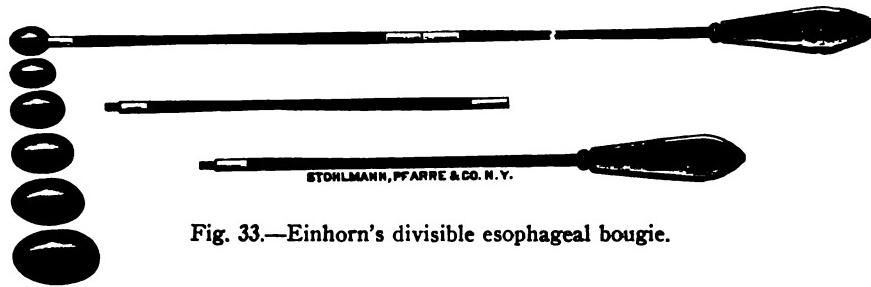


Fig. 33.—Einhorn's divisible esophageal bougie.

drawn. Care should be taken not to diagnose the presence of a stricture at the site of the laryngopharyngeal junction, because sometimes in normal persons, even though the head be thrown well back, a marked resistance to the entrance or exit of the ball end may here be met with.

The passing of the instrument is very simple, glycerin or water being used as a lubricant. The head is thrown well back and the instrument after passing the laryngopharyngeal junction is pushed through the gullet and cardia, which, under normal conditions, take place without resistance. The form of instrument I ordinarily employ is the single, long whalebone shaft with white ivory olives, somewhat more pointed at the tip than those depicted above. (Fig. 33.) These can be obtained in all surgical appliance houses and answer for all purposes. Such instruments being somewhat too long (60 centimeters) to be carried about, which is rarely necessary, Einhorn has suggested the modification illustrated above.

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## CHAPTER VI.

### Method of Chemical Examination.

#### MIXED SALIVA.

THE examination of saliva is occasionally indicated and may be of considerable importance. In doing this we take into consideration its quantity, reaction, the amylolytic power of its ferment ptyalin, and the presence of abnormal constituents. The examinations are colorimetric and qualitative in character, with standard test solutions of five per cent., the employment of litmus paper, and of the microscope for the organic elements. Small sized porcelain dishes (like those supplied in children's paint boxes), or a glass slab backed with white paper are necessary to note the delicate color reactions. The chewing on a piece of india rubber and the collecting of the mouth secretions will usually cause the flow of enough mixed saliva for the examinations.

The quantity of saliva secreted per day is about 1500 grams. This quantity, however, is subject to great variations even in health. The quantity is markedly increased reflexly in a number of gastric disorders, and directly by most all of the inflammatory conditions about the mouth. An increase is frequently noted in pregnancy, in neurotic conditions, bulbar paralysis, and following the administration of mercury, pilocarpine, acids, etc. It is decreased in the febrile conditions, in diabetes, often in nephritis, and in psychic disturbances, in which latter case the salivary decrease may accompany a decrease or absence of function of all of the glandular structures in the gastro-intestinal canal.

The reaction of the saliva is easily and quickly noted by the use of litmus or rosolic acid test paper. The latter is to be preferred since the use of the one paper will answer for both the acid and alkaline reactions. This paper can be made easily by soaking strips of fine filter paper in an alcoholic solution of rosolic acid of such strength as to color the paper a delicate salmon pink when dried. When applied to an alkaline saliva a change of color to a brilliant red is noted, the degree of brilliancy depending on the degree of alkalinity; but if the saliva be acid (which is rare) a change to a yellow is seen. Since saliva is normally alkaline, and when acid only faintly so, a negative result with the rosolic acid paper should be followed by the more sensitive to faint acid litmus; a carefully neutralized solution of azolitmus answers best of all for these examinations.

Not much significance can be attached to the reaction, because it varies under normal conditions and in different individuals, and may continue normally alkaline in pathological conditions. While an alkaline reaction is the rule, still in disease of the intestinal tract, in febrile diseases, in diabetes, in gastric cancer and in hysteria it may be acid. In late gastric cancer this is commonly observed, and is then most probably due to the presence of lactic acid in the mouth left from the vomitus. It may be present as an excretion of the salivary glands, or caused by fermentation of micro-organisms present in the mouth. In these latter mouth or dental conditions (caries), the acidity may be due also to the presence of small quantities of oxalic acid. Fermentation effects of the lactic acid bacilli in the mouth on sugars give acid reactions (diabetes).

Important indeed in gastro-intestinal work are the estimations of the diastatic power of the saliva. While hasty eating, insufficient chewing and insalivation would cause to be delivered into the stomach less ptyalin for carbohydrate conversion, and this might cause the development of gastric symptoms, such is only a relative condition (in those instances the ferment examinations of the saliva would show this secretion to be normal) and thus are not considered here. There are conditions of gastric dyspepsia, however, which are apparently directly and specifically due to the diminution or absence of the quantity of ptyalin secretion. Such may be seen in neurotic and psychical conditions; atrophy of the salivary glands (when the entire true salivary secretion and sense of taste in the anterior two-thirds of the tongue are lost); in what, for the want of a better term, may be designated general-neurological-atrophic disease wherein gastro-enteric, spinal cord, and retinal atrophy are present; in some of the associated medical diseases, such as chronic nephritis, diabetes, Addison's disease, and ascitic conditions. Whenever in non-malignant diseases of the gastro-enteric tract the gastro-intestinal secretions are lacking in quantity or character, it is always desirable to test the amylolytic power of the saliva before the institution of a heavy carbohydrate diet, for if this mouth secretion is also deficient or of poor enzymotic quality it immediately becomes a question as to whether the institution of such a diet would be well borne by the stomach of that individual. This examination is not so often necessary (although still desirable) in states of increased gastric-juice secretion where the examination of test-meals shows a poor starch conversion due, most probably, to the inhibitory effect of the high HCl content on the ptyalin in the stomach.

The ptyalin is fairly resistant to external influences, and its action upon the hydrated starches is immediate. Leaving out of consideration

the starch examination of the gastric filtrate and considering only the direct examination of the saliva, the simplest test for the presence of the ptyalin and a fair estimate of its quantity may be performed in the following way: About 5 cubic centimeters of saliva are filtered through very fine filter paper and added to an equal quantity of a weak solution of hydrated starch. The test-tube is shaken, placed in a warm chamber for from 5 to 10 minutes, and then examined with one or two drops of plain tincture of iodine or Lugol's solution. The striking of a distinct blue color shows that too little or no ptyalin at all is present; a red or violet, that it is present in fair amounts (erythrodextrin); no color at all (achroödextrin), or a much lighter reddish color than the above (erythrodextrin and achroödextrin combined), that the amount is surely normal. A control test may be made with a portion of starch-saliva mixture by means of estimating the presence of maltose sugar by its reduction of Fehling's solution; the latter can be used in the first instance as a qualitative and quantitative test, for if a distinct reduction of the Fehling's is obtained it may be considered that a normal amount of ptyalin is present in that saliva. Care must be exercised that the starch solution is not viscid, that it is cold when added to the saliva, and that the temperature in the chamber is around 37°C.

Qualitative changes in the various chemical constituents of the saliva are commonly noted. They are found to be of significance in other conditions of internal medicine and states of the general body as well as in those of the gastro-enteric tract alone. Among these, in a general way, may be mentioned the following: The sulphocyanides disappear from the saliva when bile is diverted from the alimentary canal (Fenwick). In severe cases of obstructive jaundice I have found this was so in four of the cases, and not so in seven. The return of the sulphocyanides in the saliva during an illness and the diminution of the amounts of ammonia have been considered good omens in grave illness as indicating a returning better state of conditions in the nervous system (Le Roy). Acetone is commonly found in the saliva in toxemias from the intestinal canal. In chronic nephritis there is an increased amount of urea in the saliva. Opium or its alkaloid, no matter how taken, may be detected in the saliva a few minutes afterward; thus it is a test of value in detecting the cases of morphinism which give gastro-enteric symptoms of an obscure origin.

Simple tests for the presence of the above mentioned substances are performed as follows:—

*Sulphocyanides.*—To the side of a large drop of saliva add a drop of slightly acidified solution of ferric chloride; if the sulphocyanide are present in normal quantities there will be a faint pink coloration

at the contact area, which afterward spreads throughout the saliva. The color will be a deeper pink and even a red when the sulphocyanides are increased.

*Ammonia*.—Add a small drop of Nessler's reagent to the center of the drop of saliva; if ammonia be present a reddish-yellow color will develop at the site of the drop with a faint pink aura around it.

*Acetone*.—Add a drop of very faintly red alkaline solution of sodium nitroprusside; if acetone be present a ruby red color is produced which changes to a yellow. Now add an acid (acetic) and boil, when a blue or a violet color will result.

*Urea*.—Take 5 cubic centimeters of plain saliva and evaporate over a water bath to about one-quarter, add alcohol, shake well, filter, evaporate to dryness, dissolve residue in distilled water, treat with a drop or two of nitric acid, wait a while, and the characteristic rhomboidal or hexagonal plates of nitrate of urea will be found.

*Opium*.—The same test and color reaction as for the sulphocyanides, only subsequently add a drop of corrosive sublimate solution and if the color is due to the sulphocyanides it disappears, but not if iron meconate has been formed, in which latter case it remains unchanged. For detecting morphine, a neutral ferric chloride solution is best, or a drop of neutral ferric alum. Both give a dirty green color if positive.

Of the micro-organisms found in the saliva where pathological conditions about the mouth are present, it may be said that in the inflammatory states of the gums and mucous membrane those normally present are found in greatly increased amounts, with leucocytes, shreds of necrotic tissue and red blood-cells as common findings. In cases of actinomycosis, the ray fungus may occasionally be collected at the gingival margins of the teeth or from the interior of the mouth tumefactions. In children with thrush, and in adults with phthisis, the oidium albicans are commonly seen. The pus producing organisms are present in ulcerative conditions about the mouth and in tonsillitis. The Löffler bacillus is present in true diphtheria (but may be found in normal mouths), or for weeks after an attack of this disease. A streptobacillus is commonly present in the mouth in scarlatina and glandular fever. The tubercle bacillus is often seen in the saliva of patients who have pulmonary tuberculosis with expectoration, and but rarely in lupus or tuberculosis of the mouth.

#### VOMITUS.

The examination of the vomitus is sometimes of importance in the diagnosis of gastroenteric affections, and it may be said that the more

severe the affection the more valuable are these examinations. In some cases of acute gastritis of the simple dietetic type, in neurotic conditions, and in reflex vomiting from other causes, usually little can be learned, excepting possibly to assist in making a diagnosis in the negative way.

In examining the vomitus, note should be made of its appearance, quantity, odor, chemical reaction, microscopical findings, and the presence of abnormal constituents.

Considering such, it should first be stated that the findings of large quantities of undigested food several hours after a meal may be seen in acute gastritis, the neurotic affections, gastrophtosis and allied conditions, and in chronic gastritis, particularly the atrophic and cirrhotic forms. In gastric cancer and all severe types of pyloric stenoses, vomiting of food remnants taken hours or days before is common (collective vomiting). A form of vomiting not so pronounced as this may be seen in hour-glass contraction, or severe states of myasthenia. It should always be noted whether the food seen is digested, only partly so, or not at all, and which of the different foods have been the best or least digested. When all foods have been well digested, the vomiting is usually neurotic or reflex in nature. The albumins (meats, fish, etc.) are usually found well digested in states of high gastric juice secretion, and the carbohydrates when this is low. In the face of a high acid-enzymatic content in the stomach increased amounts of mucus (gastric or swallowed) will interfere with the albumin conversion, but not so much as with that of the carbohydrates. In instances of an acute onset of vomiting from dietetic reasons, little reliance should be placed on the examination of the vomitus—this also holds true in the more or less chronic gastric cases. The reason of this is that such vomitus usually contains large quantities of undigested foods, no HCl or pepsin, and large quantities of organic acids caused by the acute cessation of gastric digestion, which cessation, after the obnoxious contents of the stomach have been removed, may quickly disappear and be followed by the establishment of more or less normal stomach function and better digestion.

When, however, such vomiting is a more or less constant feature in cases of stomach disturbance, more reliance can be placed upon the character of the vomitus, particularly should these be approximately the same each time. In such instances, more or less digestion and the presence of HCl are commonly seen. Small amounts of undigested food are of no significance in any diagnostic way. Vomiting of the stomach contents should be distinguished from regurgitation of undigested food mixed with mucus and saliva. The latter is present in many forms of

stomach affections, and to a more marked degree in stenotic conditions of the esophagus and cardia. Where vomiting from the esophagus exists, the foods will be returned as swallowed, and an admixture with gastric juice is absent. A vomit which contains hydrochloric acid is most probably from the stomach, and that containing bile is positively so.

Some significance can be attached to the odor of the vomit. During the height of normal gastric digestion the stomach contents have a slightly acidulous smell—not pronounced or markedly unpleasant. When the vomitus is strongly sour in odor (absence of digestion and presence of fermentation), the organic acids are usually present in easily appreciated amounts. It is of a fecal odor when for any obstructive reason regurgitation of chyme or fecal substances has taken place from the intestines into the stomach.

The taste is that of the food taken a few hours before, or it may be indifferent in nature, as in acute gastritis, the psychic and neurotic conditions, in a few cases of gastrophtosis, or sometimes in vomiting of a reflex nature. It is acid in states of increased gastric juice secretion, and bitter in gastric stagnation from any cause, or when the vomitus is mixed with bile.

Of the distinctly abnormal products that may be found in the stomach and concerning the character of small amounts of vomited matter in different disease conditions, the following should be mentioned:—

**Blood.**—As a small amount or streak of blood may be commonly noted where severe retching or straining at vomiting occurs, it is of no great significance (since in these instances it may come from the pharynx, esophagus, trachea, or mouth). When it is large in quantity and more or less altered in character, it is indicative of its collection in the stomach. Such bleeding may be present in cases of ruptured varix of the stomach, bleeding of a large vessel in an ulcer base, from the ulcerated surface of a carcinoma, from punctate ulcers, intense hemorrhagic affections of the mucosa, in thoracic aneurisms rupturing into the gullet, in vicarious menstruation, in ulcer of the lower esophagus, and the returning of swallowed blood from the nasal cavity or pharynx. Early in acute gastric ulcer, and generally in the soft forms and late in the hard forms of gastric cancer, a vomiting is often seen which is quite frequent and small in amounts, consisting mostly of mucus, foods, gastric secretion, and blood. Such vomiting may be quite reddish in color, although usually it is brownish or green. (See blood tests.)

**Mucus and Saliva.**—These are present in most all vomitus, but when observed as the main constituent of the ejecta from the stomach they are most significant of a state of chronic gastritis. The mucus is

usually recognizable with the naked eye (glassy appearance), by the microscope, and by its chemical behavior with acetic acid (not dissolved).

*Pus.*—This, unless large in quantity, is rarely seen by the naked eye, but is most easily demonstrated by the microscope. It is found mixed with the vomitus in cases of phlegmonous gastritis, in rupture of a gastric abscess, in infective ulcerated states of the stomach (cancer), in subphrenic abscess, in fistulous states from suppurative pancreatitis, abscess of the liver or small and large intestine, or if swallowed from the air passages, mouth, or gullet, and collected in the stomach. In carcinoma affecting the fundus or lesser curvature, the vomiting of pus is, as Strauss<sup>1</sup> has pointed out, a diagnostic symptom of much value. In one of my cases of cancer of the lesser curvature, in which the growth did not involve the pylorus, a mucopurulent vomiting from the empty stomach was a rather constant feature.

*Bile.*—Bile is frequently found in vomited matter whenever the vomiting is severe or frequent. When constantly present in large amounts with pancreatic and intestinal secretions it is usually due to stenotic conditions of the upper portion of the small intestine. Bile itself can usually be recognized by the naked eye, but in doubtful cases tests for the bile constituents may be employed. For these and also tests for pancreatic juices, consult Chapter VII. The vomiting of bile-stained mucus and fluid are commonly seen in migraine, centripetal and reflex vomiting from the various causes, and in severe types of acute gastritis.

Other abnormal substances occasionally found in the vomitus are particles of mucous membrane or tumors (the detailed examination of which are of great importance in the diagnosis of gastric conditions); fecal substance, which can be detected by its odor and the examination of a distilled portion for the presence of indol, phenol, and skatol; intestinal parasites, such as the round worm, segments of tenia, ankylostoma duodenale, trichinæ, hydatid cysts from echinococcus of the liver when these have ruptured into the stomach, and the larvæ and embryo of insects.

#### METHODS OF EXPRESSING TEST-MEALS.

For the purpose of obtaining definite information of the state of gastric secretion, the dynamic power of the organ, abnormal findings pertaining to the stomach, or perverted states of the conversion of foods, the employment of test-meals is essential. The technique of introduction and the care and the best forms of tubes to employ for this purpose have been described. The two methods employed in

extracting stomach contents are the aspiration and the expression methods, and since a knowledge of both is desirable in the routine of gastric work they will be considered in some detail.

**Aspiration Method.**—Apparatus of assistance in the aspiration of stomach contents include a pump (Kussmaul), a stiff rubber sphere, and a bottle with an exhausting syringe. A length of outside tubing reaching to far below the level of the stomach may, by syphonage, empty the organ; this is practical for the return flow in lavaging, but for obvious reasons is not worthy of consideration in test-meal extraction.

The employment of the Kussmaul pump is much too strenuous a method for obtaining stomach contents. It entails the use of a complicated and difficult to clean mechanical pump, the dangers of which have obviated its use even by the ambulance surgeon in his emergency poison cases; the same holds true with all forms of apparatus that are applied directly to the end of a stomach tube (rubber

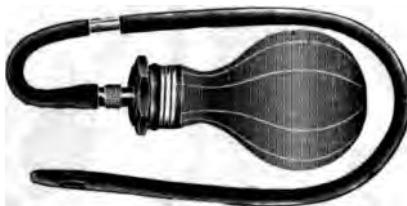


Fig. 34.—Ewald aspirating bulb.

spheres, syringes). I feel that much of the injury and prevalent opprobrium of suction can be attributed to the inevitable direct suction exerted by them in their use, for when at work such an apparatus practically converts the entire length of the stomach tube into a part of a syringe, the end holes of the nozzle of which play directly upon the gastric mucosa. The danger of harm through the detaching of particles or sections of mucosa is plain. If an assistant manipulates the ball or syringe there is always danger of a too forcible suction, for usually, the slower or less the return, the more energetic are his efforts. Of course, with the bulb in your own hand you will be more careful, but still it is difficult to regulate its degree of force, and, in a rash moment born of discouragement at the poor results in the way of return, one is very liable to send in a charge of air (to free the end holes of the tube or straighten out the kinking of it) followed by a much too forcible suction.

Lastly, suction can be exerted by the employment of a bottle more or less freed of air on the principle of the apparatus recommended by Fürbringer<sup>2</sup> to remove pleural exudates, and which has been modified by different observers since its introduction. Among

the first to employ such an apparatus and draw attention to stages for aspirating stomach contents was Boas. Thi employs a Woulffian flask, or a one-necked glass flask the which contains two perforations. Two glass tubes, as w sible, are introduced into the openings, one of which c means of a rubber tube with the stomach tube, while t joined to a Potain syringe or a rubber balloon, which e air (Boas<sup>3</sup>). My objections to the use of the Potain syring degrees of exhaustion in the flask are always more or less t; the syringe may not work properly; the cork and glass not fit tight enough to maintain a suction force throughout th

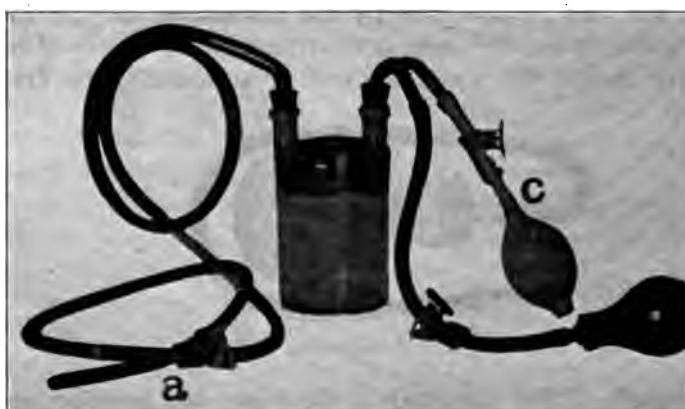
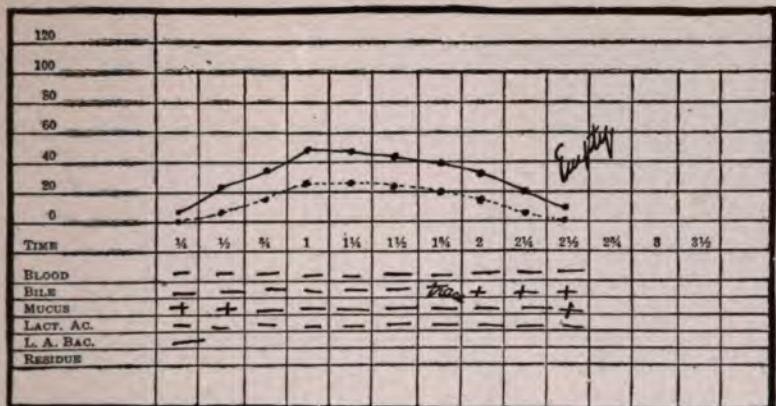


Fig. 35.—Author's test-meal bottle. *a*, Stomach-tube with this tube is joined, by means of a straight glass tube, to the tube which is fastened to a short bent glass tube which goes through the cork into the neck of the bottle on that side. *b*, Rubber aspirat tube and cut-off; this bulb mildly exhausts the bottle of air. *c*, bulb, tubing and cut-off for delivering air into the bottle and stoma tubes of both of the bulbs are fastened on a glass Y which had bee shown in the illustration.

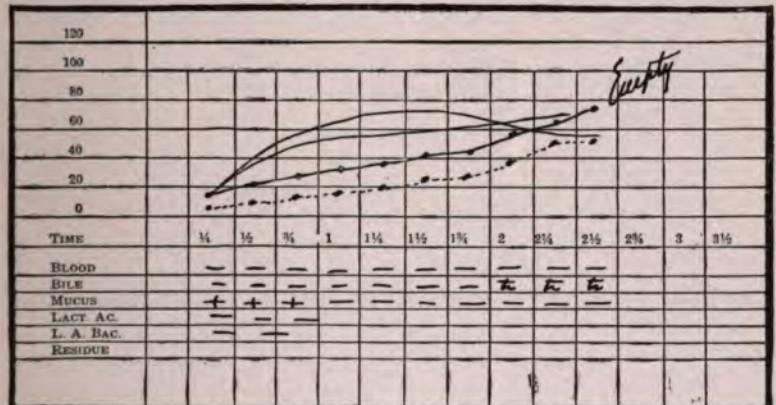
extraction, particularly when the bottle is large in size or abundant in quantity; that an assistant is usually necessary in it tion; and that a too strong degree of force may be exerted. reasons, and because by its use the inflation of the organ i accomplished at the time of the extraction of the test-meal, from a recent article of mine in which was advanced a mod the Boas apparatus. (Bassler.<sup>4</sup>)

"The flask is a simple, heavy, two-necked bottle of 500 cub capacity, on which are marked graduations (diamond ink may be u from 20 to 260 cubic centimeters; two long marks at the right of 2

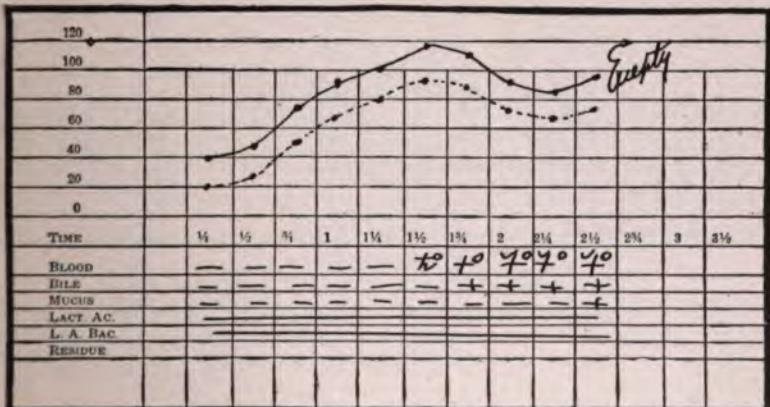
PLATE XLVI.



(1) Normal Type.



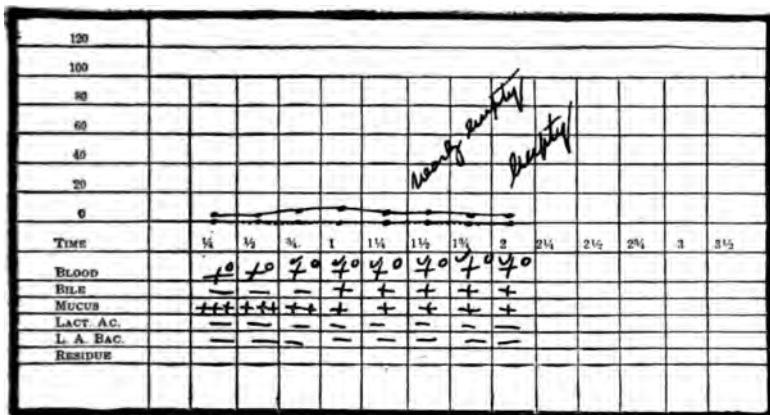
(2) Reflex Type.



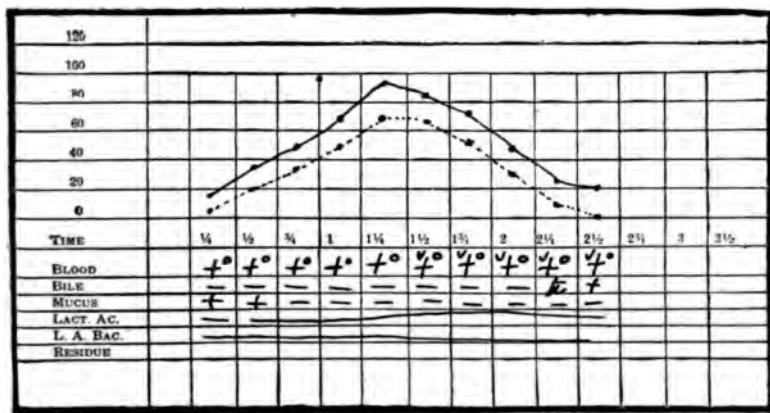
(3) Duodenal Ulcer.



PLATE XI.VII.



(4) Achylia Gastrica.



(5) Gastric Ulcer.

Fractional test-meal estimations showing a composite of cases to arrive at a fairly accurate standard. It must be remembered that considerable departure from the above is commonly met with in the subjects mentioned.



centimeters show the limits of normal returned quantities from an Ewald and Boas meal. In the left rubber stopper, is a single bent glass tube connecting by means of a length of tubing, on which is a cut-off, with a straight glass tube that fits directly into the end of the stomach tube. At the beginning of the expression, if the return is easy, quick, and not too distressing to the patient, this completes all there is to the apparatus. It is simply expression into a graduated bottle of small size, the right end of the apparatus being detached and therefore inconspicuous. The right end consists of a Y-shaped tube, bent downward, to which are attached the aspirating bulb (front bulb), and an inflow bulb (rear one) for the purpose of inflating the stomach after the meal has been extracted. This right end can be quickly plugged into the right neck and be brought into use in an instant of time. The extracting limit of the aspirating bulb is about 55 cubic centimeters, thereby making the degree of suction from the bottle from *nil* to only and always a safe and easily regulated degree of force. The attachment of the two bulbs on the one stem does away with the necessity of changing the aspirating bulb around for the purpose of inflation. The bottle and tubes are easily cleaned, the right end never coming into actual contact with the meal. The graduations on the bottle mark the upper meniscus, as the meal is generally turbid.

"It is true that all this means "apparatus," and apparatus sometimes suggests to an apprehensive patient a "pumping out of the stomach." But in this regard my experience with the bottle has not been discouraging; on the contrary, patients have often expressed words of surprise and pleasure that it was all done so much quicker and with less distress than had been their experience on other occasions when the tube alone had been used, and I have been so well pleased with the employment of it that I feel that I can heartily endorse its use. For it is true that under all conditions, particularly when extracting a test-dinner or when there are obstructing particles of food in the chyme in the stomach, it is decidedly more satisfactory than when depending upon expression alone. With the proper degree of thoughtful manipulation and skill with a bottle like this, a stomach can be emptied quicker and more positively, with less distress to a patient, and surely with no added dangers to the integrity of the gastric mucosa, than by the unassisted simple expression method, and I say this after an ample experience, a close consideration and observation of the subject, and the minute examination of thousands of extracted meals."

As time has run on, I have further tested the advantages of the use of this bottle in my office work with that of the simple expression method in my clinic and hospital work, and I have come definitely to the conclusion that not only is its use much more satisfactory in the ways above mentioned, but that the entire stomach contents can always be secured, and by a means decidedly less liable to cause injury to the mucosa than when the expression method alone is employed.

**Fractional Test-meal Extraction.**—In fractional test-meal extraction, a small soft tube of the caliber of a duodenal tube with an end piece with fenestra large enough to permit the meal to enter easily (Rehfuss, Lyon) are essential. A small glass surgical syringe, the tip of which fits snugly the upper end of the tube, is required to make aspiration each 15 or 30 minutes according to the interval employed. The tip end of the

tube is swallowed when the test-meal is ingested, which when well done is far less distressing than the introduction of the larger tube. It is handy to have a series of small beakers numbered in series. In my own work the aspirated stomach content is examined not filtered, and caution is exercised to aspirate only the quantity required for each extraction—namely 5 or 10 cubic centimeters. The classical Ewald meal is employed—there being no point or reason for using any other. This is simple, accessible, readily withdrawn and capable of showing both secretory and motor variation as well as pathological products.

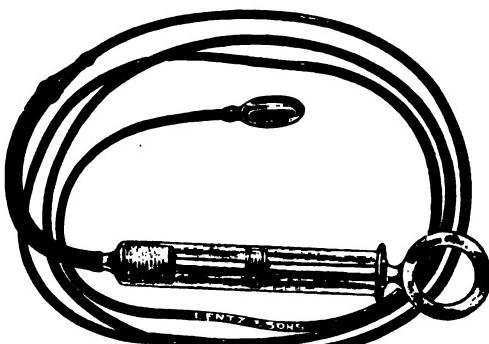


Fig. 36.—Rehfuss tube.

### AUTHOR'S CARD TO PLOT ACID CURVES.

N/ 10 Na O H	NAME	ADDRESS	No.
120			
100			
80			
60			
40			
20			
0			
Time	1/4	1/2	3/4
Blood	1	1 1/4	1 1/2
Bile	1 3/4	2	2 1/4
Mucus	2 1/2	2 3/4	3
Lact. Ac.			
L. A. Bac.			
Residue			

**Simple Expression Method.**—This method was introduced by Ewald and Boas,<sup>5</sup> and has received, because of its simplicity and absence of apparatus required, universal adoption. To accomplish it necessitates merely the passing into the stomach of a stomach tube through which by abdominal effort the patient ejects the stomach contents. In the plain test breakfast (35 grams of wheat bread and 400 grams of water) and under favorable conditions it suffices for routine work. But as a method of extraction it is even more liable to injure the gastric mucosa than is aspiration by means of the intervening bottle, although less so than any suction apparatus applied directly to the tube.

All degrees of success with the use of this method are met with. It may be most satisfactory in the way of emptying the stomach of the test-meal, often only moderately so, and occasionally, when much uncontrollable straining exists and kinking of the tube in the stomach occurs, shutting off the return, or when the normal stomach contents are too viscid to rise through the tube, or the stomach contains particles of food large enough to occlude the tube apertures, it is of no value. No more discouraging moments exist than when, after the taking of a test-meal and the patient is ready for its extraction, there is a poor or negative result in its extraction. As case after case comes to us we see that even in the most skillful hands this discouragement is met with if dependence is placed entirely upon the Ewald and Boas method alone. Of course, if we are satisfied with obtaining less than the entire quantity of chyme present in the stomach, then no more need be said. But surely to do the proper kind of scientific gastric work, a greater quantity of gastric juice than 10 or 20 cubic centimeters is required. Even in the chemical examinations for acidity, not to mention the other important examinations, what can you ordinarily do in the way of accurate laboratory diagnosis with only a few cubic centimeters of unfiltered chyme?—just a paper or Günsburg test for its reaction, a makeshift quantitative estimation of total acidity, a few drops for the starches and maltose, a slide or two for the microscope and loops for cultures, and it is all gone. How about a knowledge of the total quantity, so necessary for estimating the condition of motility and patency of the pylorus; the amount of incorporated mucus that rendered the chyme too viscid to raise through the tube; the undigested food substances (skins and frame work of vegetables, fascia from meat, etc.) from an early breakfast hours ago, possibly from supper the evening before, the particles of which had occluded the eyes of the tube; the proper quantitative and qualitative examination of all the acids (hydrochloric, lactic, butyric and acetic); the thermostat tests for fermentations; the chemical tests for

blood, albumoses, peptones, and conversion stages of starch to maltose, and so on through other examinations which may suggest themselves as being important in a case? No; it is essential that with every test-meal extracted the stomach should be emptied, and for this, as well as for further reasons stated, a mild degree of steady suction such as is exerted by the author's plan of apparatus is required.

Does a stomach tube always follow the course in the stomach as suggested by Boas?<sup>6</sup> Not always. To prove this to myself, on a number of occasions, I passed a soft tube half filled with bismuth emulsion (Chapter V) into stomachs of different shapes, sizes and under different conditions, and by means of the X-rays and fluoroscope demonstrated that this was not always so. The course that the tube generally took on the floor of the organ—whether the convexity was toward the pylorus or fundus—depended upon where the tip of the tube engaged on the floor of the stomach, upon the uplift of the lower region of the organ in the act of vomiting at the contact time, upon the condition of peristalsis at that (the contact) point, and upon the shape and size of the organ.

To understand how a stomach tube can kink under the influence of vomiting explains fully the reason why the return of a test-meal sometimes stops in the middle of a jet during the expression method, and also why at times it does not return readily when the conditions for its doing so are apparently favorable. In my opinion, it is due to the kinking of the tube from the uplift of the stomach in the act of straining necessary to the performance of this method, for, unless the tube is held so that its end is just below the cardia, the return, in the majority of instances, must be stopped by the kinking. Further, to note the striking of the greater curvature of the stomach on the tip of the stiff, straight tube as one draws it in or out to seek the level of the stomach contents, causes a rather unpleasant apprehension within oneself as to the harm to the mucosa that may be caused by this method. What other explanation than this is there for the often seen blood tinged last few cubic centimeters of a test-meal, and for the occasionally found particles and pieces of glandular layer of the stomach returned by the simple expression method—I mean in cases that are not ulcer erosions, malignant diseases, congestions of the stomach, etc. Personally I believe that there is less danger of harm to the stomach if we introduce the tube far enough to lie securely along the floor of the organ, no permitting or encouraging the patient to strain, and then aspirate the contents by some gentle suction method, for then when blood is present in the test-meal it possesses diagnostic significance.

In practicing the simple expression method the tube is introduced to the mark noting its position in the stomach, after which the patient

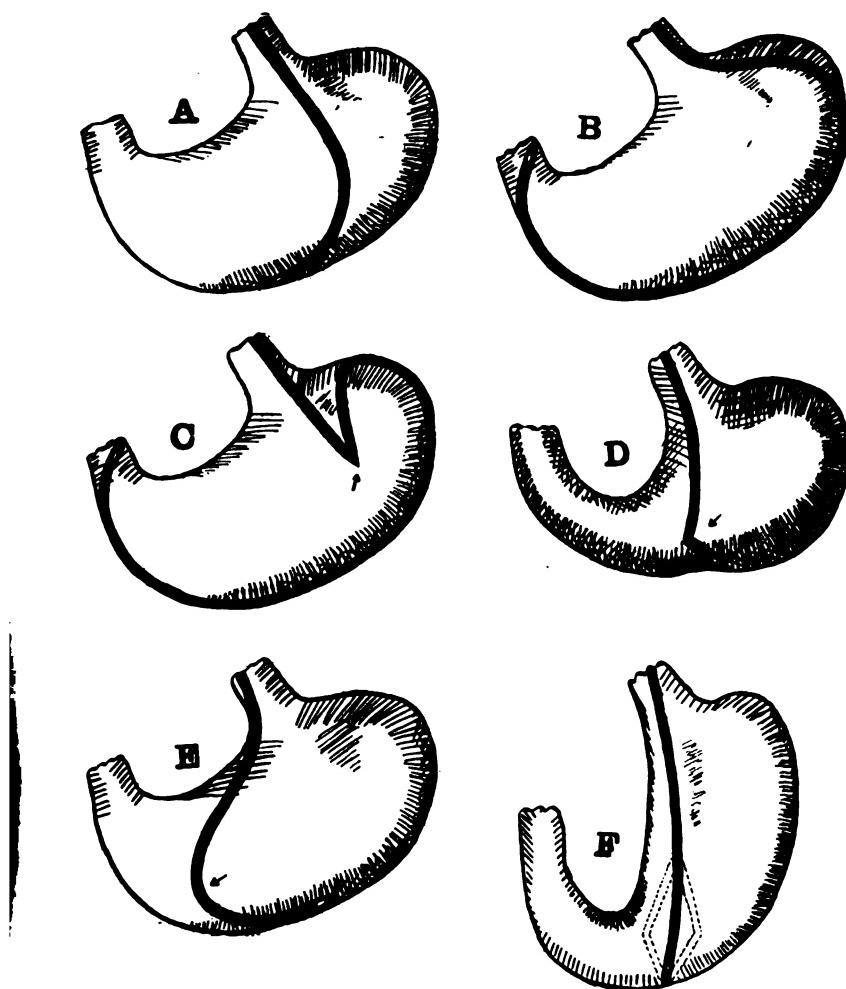


Fig. 37.—Showing the various positions of a stomach-tube within the stomach. *A*, Shows the proper position of a tube on the floor for test-meal extraction and lavage. *B*, The tube pushed in further when the end of the tube crosses to the beginning of the lesser curvature as the tube continues upon the entire length of the greater curvature and to the fundus. *C*, A sharp kink in the tube if continued further than *B*, indicated by the arrow. *D*, A possibility when an effort at vomiting is made as the tip of the tube engages on the floor, indicated by arrow; such a kink, just above the apertures, can take place when the tube is arranging itself as in *A*, but in the latter case it quickly corrects itself by the end sliding downward. *E*, Shows the tube of *D* continued in the uncomressed stomach, the arrow points to the location of an inevitable kink which renders all passage through the tube impossible. *F*, Tube in the stomach of ptosis, showing that the tube generally engages directly on the floor at the lowest part of the stomach, after which the dotted lines show that it may then bend in either direction.

is asked to strain as if at stool. The tube is withdrawn or introduced to different levels if the return does not immediately occur, and this is slowly practiced until the flow takes place, at which point it is maintained during several efforts of the patient, after which (when no more flow occurs) a new level is sought, and this continued until it is supposed that the stomach is empty. One should be careful to manipulate the tube in a slow and steady way, remembering that no flow can take place from it excepting during the straining times. In employing this method one should not be hasty in withdrawing the



Fig. 38.—A small particle of gastric mucosa removed from a stomach during the extraction of a test-meal by the expression method. About X 50.

tube when no more return is accomplished, because often when one would suppose that no more contents are present in the stomach, a flow is again established—possibly even greater in amount than had before been observed. At the end of the performance, the outer end of the tube is tightly pinched (so that in its withdrawal its contents do not flow into the patient's mouth or soil his garments), and quickly withdrawn by a single sweep of the arm forward and upward. In the aspiration method, the tube is rendered free from contents at the time of its withdrawal, by an extra pressure or two on the bulb.

To a practical extent, the first introduction of a stomach tube is rapid and comfortable, and the results in the way of test-meal extra-

ion satisfactory according to the degree of technical skill of the physician, his ingenuity in disarming the apprehension of his patient, and the response of the patient in following his directions. When a test-meal has been prescribed (unless the specific question is asked, which is seldom), it is best to make no mention or suggestion of its removal at the time. "When you return I will test the digestive power of your stomach," or statements of that sort are generally all that are necessary to close the visit preceding its performance; for often, only the mention of the word "stomach-tube" harbors up in the uninitiated mind the horrors of the Kussmaul pump and other trained and unfavorably influencing apprehensions, and such, inervously inclined individuals, laboring with fear and anxiety while the meal is in the stomach, may markedly affect the regular secretion of gastric juice, or from dread may inhibit gastric secretion altogether.

If a patient is present who is accustomed to the passing of the tube, it may be wise to demonstrate its introduction and harmlessness to the new patient. If not, keep the tube out of sight until the patient is seated and properly protected by a rubber apron which buttons high around the neck and covers the knees. A reckless sang-froid manner on the one hand, and an unwise degree of fear and hesitancy on the other on the part of the attendant are both unfortunate demeanors. Usually, at the time of the extraction the less said the better, and an easy, quiet, confident mien, with everything on hand, and a few words telling the patient to swallow when you ask him to, are all that are necessary. The tube should be quickly introduced to the laryngopharyngeal junction, the patient told to swallow, and when this is done the tube is pushed with short, quick strokes (one hand after the other) into the stomach, at which time the patient is commanded to breathe deeply so that he will note that breathing is possible. It is always advisable to have a closed cut-off near the outer end of the tube so as to prevent the loss of some of the meal and the soiling of the patient's clothing, and the floor. When the tube is *in situ*, such words as "you have done nicely"—"the worst part is over," or some encouraging remark pertaining to his illness is often diverting.

From now on, success in the procedure of the extraction of the meal is usually enhanced if the patient's attention can be fixed on something. I have tried Boas' advice to compel the patient to keep looking into my eyes, as well as other suggested plans, but have discarded them all as useless. It must be remembered that unless the patient is one of the tube-broken, resigned, or very confident type, the only thing in his mind's eye is the length of tubing within him, and the attendant distress of gagging and retching it causes. In the simple

expression method, to have the patient hold a receiving bottle in the left hand and caution him to observe that the end of the tube in the neck, and occasionally ask him to raise or lower the bottle so on as you direct, are of value. With the use of the aspiration by means of the bottle, the manipulation necessary usually so diverts his attention from the discomfort of the tube. At the moment, the cut-off is opened and suction begun, which, by the author's bottle, usually causes a flow of the meal after four pressures of the bulb, and the stomach is emptied after a few squeezes made at intervals as may be necessary to maintain a vacuum within the bottle.

#### DIRECT EXAMINATION OF THE GASTRIC SECRETS BY MEANS OF TEST-MEALS, AND THE VARIOUS FORMS OF SAME.

For the purpose of diagnosing gastric conditions, the best plan to employ to awaken the functions of the organ is that of test-meals. By their use a natural impulse is given to digestion, and when the foods are of known substances and definite in amounts, comparisons can be made with the normal, and, as these may differ from the diagnoses are possible. For this purpose, test-meals, which are extracted at intervals of time after their ingestion, are employed. These possess marked advantages over other forms of gastric examination, such as thermal, chemical, electrical or indirect measures.

**Test Breakfast of Ewald and Boas.**—This answers the purpose for most of the simple forms of gastric disturbance in noting changes in secretion and, to a less extent, in motility. It is commonly used first measure in the routine of cases, and answers the purpose in the majority of cases seen. It is a fluid form easily taken and extracted, and usually borne without distress in the great majority of instances. It consists of the eating of a roll, or two slices of bread (white), weighing about 35 grams, the drinking of one and a half tumblerfuls of water, or a cup of tea without milk. This is best taken in the morning on an empty stomach, and is extracted at the height of its ingestion which is one hour afterward; although, of course, any other time of day may do. Observing that tea instead of water was commonly used, I recently took a series of cases having normal gastric secretion, and tried both fluids to note if there was any difference in the way of stimulation between the two. The figures in twenty-seven cases from eleven individuals showed that when tea was used the H

tion ran from 5 to 9 per cent. higher than when water was used. I therefore argue against the use of tea, and favor water as giving a more accurate indication of the gastric secretion.

The range of normal amount of return is between 20 and 70 cubic centimeters. Increased amounts above 70 cubic centimeters are just as significant of gastric disturbance as 20 cubic centimeters or less—these amounts, of course, assume that the stomach had been emptied at the time of extraction. Increased amounts are usually seen in conditions where there is an increased secretion of gastric juice from any cause, when in stagnant conditions contents had been present in the stomach before the meal had been taken, in hypomotility, and in spasmed and stenotic states of the pylorus. Among such conditions may be mentioned marked hyperchlorhydria and gastrosuccorrhea, in primary myasthenias, in pyloric stenoses both benign and malignant, in asthenic states of the musculature from reflex or direct neurotic or nutritional reasons, and in pylorospasm, and so on. Low amounts of return are seen in hypermotility from local or constitutional reasons, asthenic disturbance in the normal pyloric reflex, and in more or less constantly relaxed states of the pylorus itself.

A card or slip of paper printed like the following, can be given to the patient and is of assistance in insuring that the necessary directions are definitely carried out. When the test-meal is taken in the morning, the first part is stricken out.

On ..... eat a light breakfast, taking no meat or fruit.  
Do not eat or drink anything or take medicine between breakfast and time of test-meal.

At ..... sharp eat one roll or two slices of bread (no butter), and drink a full glass and a half of water. After this come promptly to the doctor.

**Test Dinner of Leube-Riegel.**—The so called "mixed meal" consists of a plate of beef broth (about 400 cubic centimeters), a large portion of meat (preferably beef about 150 grams), purée or mashed potatoes (50 grams), and a roll of wheat bread. The time for its removal is three or four hours after ingestion, when it is examined as to its chemical nature, and particularly as to the amounts and condition of the foods in regard to their extent of digestion.

The use of this meal is of value in the accurate diagnosing of stomach conditions—even more so than the test breakfast. This is because of the character of the meal, and the fact that meat takes a longer time to leave the stomach than only the wheat bread of the Ewald meal. As standards for estimations, we consider that the simple

test breakfast should leave a normal stomach in about two hours; that because of the addition of the potatoes, the quantity of carbohydrate in the mixed meal is about doubled and that this, therefore, might delay its total exit to a slight extent (although usually not more than two hours longer than when this quantity of carbohydrate is taken alone); that a plate of beef broth should have left a normal stomach in about three hours, and that the meat itself should be out in from three to four hours' time (Penzoldt's observations).

We then additionally consider the mixed character of the meal on the basis that, because of the delaying presence of the meat on the carbohydrate constituent, a longer time for the exit of all is needed—a stomach in the process of digestion empties a mixed chyme and not just one food constituent and then another as these may be ready for intestinal digestion. Therefore, because of this, and the stratification which occurs with this meal, the carbohydrates are always found present in various stages of conversion to the very end of the exit of all, which in the normal stomach can be considered as surely occurring within five hours. A word of caution should here be given in assuming the existence of pathological conditions when five or six hours afterward small quantities of foods are extracted, for, while the great bulk of the meal is gone, tarrying remnants of food may be present even in the perfectly normal stomach up to the sixth and even the seventh hour after the time of ingestion.

If at the sixth, seventh, eighth, and so on, hour of extraction after the taking of a mixed meal considerable quantities of the meal constituents are obtained from a stomach, the existence of the following conditions should be considered, namely: pyloric obstruction, states of atony, a combined atony and obstruction, a more or less low state of digestive disturbance from degrees of subacute and chronic gastritis accompanied with poor stomach function, and the existence of neurotic conditions of a depressing type affecting the entire motility of the organ. It must be evident that should the meat taken be of the tough variety of beef, or if swallowed in large particles, a delay in its disintegration would take place in the stomach. For these reasons, and because particle of such undigested meat would obstruct the tube and seriously interfere with the emptying of the organ by the stomach tube, the author advises that chopped meat be used in the mixed meals. After many examinations of mixed meals I have come to the belief that when the chopped meat had been taken and a considerable quantity of it obtained at the six, seven, or eight-hour interval, the case should always be looked upon in a serious light.

It is evident that a meal having the proteid constituent of the quality and amount that the mixed meal has, would stimulate a greater flow of gastric juice. Thus it is, that the total chlorine content of them is usually above that present in the roll and water meal, although this may not be manifested in the amounts of free hydrochloric acid (because the hydrochloric acid is combined with the excess protein—combined HCl). It is therefore plain, that, in an average way, the mixed meal is not as useful in diagnosing states of increased gastric juice secretion as is the simple Ewald meal. On the other hand, when the secreting power of the stomach is low or absent in the simple meal, the employment of the mixed meal may be of much service before diagnosing late atrophic gastritis, nervous achylia, or malignant disease—this is a very important fact. My attention was first drawn to this several years ago when achylic conditions were reported so generally in medicine, and following this to the many cases of "achylia gastrica"—the name of a symptom by the way—that were reported to exist by many clinicians. While this is hardly the place to enter into that subject in detail, the significant facts gleaned by the use of different test-meals, and the examinations of them in close detail, would permit of the following statements:—

A stomach may respond by normal amounts of acid secretion to a mixed meal, and not at all, or only to a very slight extent, to the simple meal, these small amounts of acid then always being in the combined form.

Many of the author's cases which were sent to him as achylas, showed a more or less degree of hydrochloric acid secretion in both meals, and particularly the mixed when these were examined by the Hayem-Winter method, which, it must be added, is liable to give a too low total acid result rather than a normal or too high one.

When, with the simple meal the hydrochloric acid content is absent, the examination of the secretion stimulated by the mixed one should always be performed. In doing this, the mixed meal should be prepared by the physician in double quantities, and after careful weighing of the whole, one half of it should be given, and the other half run as a control in the chlorine estimations of the extracted test-meal.

**The Lactic-acid-free Meal of Boas.**—Since all breads, rolls, etc., contain more or less milk, for the purpose of testing for lactic acid which is generated in the stomach, the non-lacteal test-meal of Boas answers admirably and is deserving of more general use. While the presence of lactic acid in test-meals is indicative only of gastric stagnation and low or absent secretion, and not at all primarily of cancer unless the growth has in a secondary sense caused these conditions, still, the

generation of lactic acid in the stomach is of much significance particularly when the suggested lactic-acid-free meal is employed in the examinations. Among such conditions may be mentioned, in addition to cancer of the pyloric region and pylorus itself, the various other causes of pyloric stenoses such as the contraction of an ulcer cicatrix, chronic ulcer with much organization of fibrous tissue, hypertrophic stenosis, the benign pedunculated growths of the glandularis, perigastric bands, pressure upon the pyloric region by extragastric formations, and well-marked chronic gastritis, etc.

The test-meal consists of about 200 cubic centimeters (7 oz.) of thin, well-cooked oatmeal porridge, which is prepared and served without milk, cream, or sugar, and is extracted in one hour after its ingestion. It is preferable to wash out the stomach the evening before, and not to allow the taking of milk or milk-containing foods for at least twenty-four hours before its extraction.

In the past, a number of other forms of test-meals have been advocated by different observers. Among such may be mentioned those of Germain Séé, Klemperer, Jaworski, Sahli, and others. Collectively they present no advantages over the ones here included, and thus have not received extensive application.

Another form of examination by the extraction of stomach food contents to diagnose pyloric obstruction from any cause (particularly its high degree seen in malignancy) should be mentioned. In this the generally employed procedure is to advise the patient to eat a full meal in the early evening and then to wash out his stomach the following morning—about ten or twelve hours afterward. Should the patient not have vomited during the night, and food remnants be found in the morning, *bona fide* pyloric stenoses can almost invariably be diagnosed. A simplification of this method (used by Mayo), and one which can heartily indorse as of much value, is the eating of several raisins in the late evening and noting if their skins or seeds are obtained in the morning lavage water. After a number of observations with this method in cases of pyloric stenoses that were not marked in extent, am convinced that it is desirable to add to the raisins several stewed prunes—or dried prunes eaten raw—simply to increase the bulk, and in doing this not to give too many raisins. See author's sieving pail.

While in this test the obtaining of vegetable skins is of much significance, a negative result does not always mean that no stenosis exists. A less complete degree of stenosis, particularly in the pyloric region but not directly at the pylorus, may give positive results with the six, seven, or eight-hour extraction of the mixed meal, but a negative finding with the Mayo method. The matter is entirely one of degree.

stenosis, in which it may be said that the nearer to the pylorus itself the stenosis is, the more accurate are the results by both methods, and the less the degree of stenosis or the further away from the pylorus it is situated, the better is the result from the mixed meal, and the less so from the Mayo method.

Since the noting of the dynamic power of the stomach is of even more importance than the status of secretion, I have in all cases used a combination of Mayo's suggestion with the Ewald-Boas meal instead of just the simple meal alone. That is, I use the raisins or prunes as one would the mixed meal in noting how long the stomach took to empty itself by giving the first as many hours before the extraction of the simple meal as desired. Ordinarily, a breakfast as noted below would have left the normal stomach in five hours' time (although a few small remnants may be left), and thus when the simple test-meal is extracted the skins would not be noted in it. The early meal may be timed before the extraction of the test-meal, five, six, seven and so on, hours. Thus, a fair idea of motility may be gained with that of secretion by the examination of the return, and only one test-meal extraction be necessary for both. However, when many returned skins are observed, the employment of the Leube-Riegel meal may be necessary or desirable.

On.....at.....o'clock sharp, eat a breakfast consisting of six stewed prunes or ten raw raisins, a little cereal, and tea or coffee. Do not eat or drink anything or take medicine between breakfast and the following:—

At.....o'clock sharp, eat one roll or two slices of white bread (no butter), and drink a tumbler and a half of water. After this, come to the doctor, showing this card to the nurse at the door on entering.

Attention should be paid to the time of day these test-meal extractions are made, the morning being by far the more preferable. Quite naturally a meal extracted late in the day, after other meals have been taken, or when the patient has been physically or nervously exhausted, may give much lower readings for the secretory and motor functions than those taken after the night's rest.

In many instances more than one extraction of test-meals is necessary for the diagnosis or to watch the course of treatment, and when suspicious findings are obtained from the simple meal, the employment of different meals may be necessary to complete the diagnosis.

**METHODS OF TESTING THE GASTRIC SECRETION  
OTHER THAN BY MEANS OF TEST-MEALS.**

Because of the fact that the extraction of test-meals necessitated the passage of a stomach tube, observers, by various means, have devised more simple and less distressing measures to estimate the status of gastric secretion and motility. After a rather extensive experience with most of them, and considering them as a class, it may be said that, while their employment may answer to a fair practical purpose in single instances, the results obtained by their use in a general way are far from as satisfactory as by the employment of the test-meals themselves; but when the use of the stomach tube is contraindicated they may be of some value. In the following description of these methods the author will delineate their limitations and the doubts which have assailed him from their use in diagnosing gastric conditions.

**Methods of Günzburg and Sahli. (Desmoid Reaction).**—On the principle that a stomach which is secreting gastric juice would digest catgut, contrivances tied with this substance and containing some chemical compound which, when freed, would enter the general circulation and manifest its presence in intervals of time in the urine or saliva, the above-mentioned method has been devised and received very general use. Saito<sup>7</sup> has shown that Günzburg and Sahli were led into error in believing (because the pancreatic juice failed to digest catgut) that when the contained chemical substance of these packages were found in the urine, acid gastric juice must have liberated them. These observers did not take into consideration the physiological fact that the pancreatic juice itself is practically inert secretion in regard to proteolytic power unless it had been activated by the intestinal secretion, and that, therefore, in the human body, catgut can be and is digested in the small intestine even when it has passed through the stomach intact. In several instances of absence of pancreatic juice secretion and a patent pylorus it was proved to me that this was so, and that but little reliance could be placed on the use of these measures for diagnosis. The instances I would particularly mention of are these: the first, a case of complete atrophic gastritis due to chronic alcoholism of long standing; the second, a case of atrophic gastritis consequent to the taking of a large quantity of carbolic acid with suicidal intention; this case being under my observation for a year after the taking of the poison; and the third, an observation made on different occasions when one of these packages had been introduced through a colostomy opening made because of the existence of

malignant stricture of the rectum. While in all, the reaction may be considered to have been delayed (three, four, and eleven hours, respectively), still no hydrochloric acid was concerned in producing the result—especially not in the last case, where the digestion of the catgut was probably due to bacterial action in the lower colon. The ferment of the stomach and intestines have a more general digestive power than was formerly believed, and there is no sharp line between the gastric and intestinal digestive processes.

*Günzburg's Method.*—The package consists of a strongly vulcanized rubber tubing (about 2.5 centimeters in length), in which is placed a tablet of 0.2 to 0.3 gram of potassium iodide. The ends are folded as shown in the illustration, and the little package is tied with three strings of fibrin hardened in alcohol. One of these packages is swallowed by the patient three-quarters of an hour after an

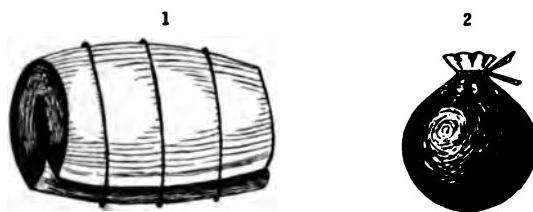


Fig. 39.—1. The fibrin-potassium-iodide package of Günzburg. 2. Sahli's rubber tissue, catgut, methylene-blue or iodoform bag (Desmoid Reaction).

Ewald meal, and the saliva tested for potassium iodide at intervals of fifteen minutes until a positive result is obtained, or six hours have elapsed. (Test for potassium iodide is by means of starch paper and fuming nitric acid.) Usually, a reaction is obtained in from one to two hours, and the rule is given that when this is not found in five or six hours anachlorhydria undoubtedly exists; when more than two or three hours elapse, hypochlorhydria is present. I have often found this latter to be the time in cases of high secretion, particularly in gastritis acida, and in asthenic disturbances of motility when the gastric secretion was normal.

*Sahli's Method.*—Sahli made an objection that the fibrin threads with which the Günzburg package was tied swell in water, and that thus the contents are liberated; he then elaborated a somewhat different method. Since one can not secure good Günzburg packages in this country (unless they have been obtained from Germany), and the ingredients for making the Sahli package are everywhere on hand, the latter method is preferable. This observer maintained that he did not advance this method for the estimation of the gastric juice secretion

particularly, but to seek information on the whole course of digestion. In this very broad assertion can be noted its limitations as a diagnostic procedure, and its inferiority to the almost as simple method of the examinations of the feces after prescribed diets.

In Sahli's method, soft pills containing methylene-blue or iodoform are inclosed in little pieces of rubber tissue (para rubber) about the size of a silver dollar, and securely tied with catgut. They are swallowed at the noon meal, and the urine or saliva tested at 5 or 7 P.M. and again in the morning. The excretion of methylene-blue can be noted by the color it gives to the urine, and the iodoform in the saliva by yielding a violet color to the starch and fuming nitric acid test.

**Methods of Obtaining Samples of Gastric Juice, and Direct Examination.**—The first of these was advanced by Edinger and consisted of a small sponge tied on the end of a length of silk string. The sponge was inclosed in a gelatin capsule through the end of which passed the string. The capsule being swallowed, in a short time dissolves in the stomach, after which the sponge is withdrawn and its contents examined. Some time later Späth suggested the use of pith globules saturated with Congo-red solution and attached to the end of a string. These are swallowed during the height of digestion and drawn up after a few minutes' time. When acid was being secreted by the stomach the balls returned blue in color. Both of these methods are of very little value, because admixture with mucus and saliva interferes with the results, and with the use of the Edinger sponges too little secretion is obtained for any practical utility.

Another way for obtaining samples of gastric contents is by means of the so-called "stomach bucket" of Einhorn. These (several sizes) consist of capsule-shaped silver vessels with an opening in the shoulder of the capsule near which is tied a string to insure its return. The introduction is made by placing the capsule far back into the throat, advising the patient to swallow, and after the "bucket" has been fixed for some moments in the stomach, it is withdrawn and its contents examined in a modified form of the usual way. Results from its employment are also far from satisfactory. The reasons for this are that the fingers must be introduced into the patient's mouth; that swallowing of the capsule is a difficult matter with many individuals (harder less distressing than the passing of a stomach tube); that more or less saliva and esophageal mucus usually get into the capsule before the stomach is reached (these are alkaline and interfere with the acid estimation of the return); that, even under favorable conditions the capsule often comes up empty or with too little gastric content for examinations of much diagnostic value, and that particles

mucous membrane, detached by the open shoulder of the capsule in the withdrawal of the bucket, are not uncommon findings within the capsule.

In my opinion, these capsules are not as safe to use as a stomach-tube; still in instances where the employment of the tube is contraindicated or not advisable (because of the straining incident to the tube *in situ*) or when patients refuse its introduction, they may be of use to gain some information of the chemistry of the stomach.

All of the chemical ways for testing the motor or resorptive power of the stomach, such as the Salol Test in the first and the Potassium Iodide Test in the second, are too inaccurate for practical utility. The Leube method of testing the motor power on the other hand is of much service and is the most convenient for the purpose. It consists briefly, of washing the stomach with 1000 cubic centimeters of water six hours after the Riegel meal, and noting the presence and quantity of food returned. As was mentioned before, slight traces of food are often found in the return from normal stomachs, but when these are present in considerable amounts, motor or obstructive conditions usually exist.

#### EXAMINATION OF CONTENTS OBTAINED FROM THE FASTING STOMACH.

Second in importance to the test-meal method of diagnosis is the examination of the contents of the fasting stomach. In fact, in the diagnosis of marked obstruction of the pyloric region and pylorus itself, the existence of a primary atrophic gastritis in which the glandular cells are still being shed, and in the more or less continuous secretion of gastric juice (gastrosuccorrhea), these examinations are of the greatest importance. Added to these may be mentioned the diagnostic significance of large amounts of mucus found in many morning stomachs in chronic gastritis—particularly of the alcoholic type—and the presence of bile, pus, blood, bacteria, fungi, etc., as these may be important. Usually, for the purposes of the examinations, the morning stomach before food or fluid had been put into it is considered as the typical fasting stomach, although these examinations may be made during the day at such intervals after meals when it is reasonable to suppose that under normal conditions the organ should be empty, excepting for a little mucus that may be alkaline or acid from admixture with slight amounts of HCl, but not containing ferment.

**Remnants of Food.**—Since the fasting stomach is empty, the finding of quantities of food from the evening meal of the day before

is a positive sign of stenosis at the exit of the organ. In conditions of primary atony of the organ, the morning stomach is usually empty even when the viscus is markedly dilated—this is a diagnostic differentiation of much practical moment. In pylorospasm it is likewise empty and the same is true of all of the other conditions of the stomach. Very slight amounts of foods are usually of no pathological significance but with HCl may denote a benign or a beginning malignant stenosis. A simple hypersecretion of central or reflex origin with some aperients. The method of obtaining these findings is by means of lavage with water.

**Gastric Tubule Cells.**—In atrophic gastritis before the condition has progressed to the final pathological change in the stomach, and in an achylous condition of the organ, the parenchyma cells can often be found. To obtain them, aspiration of the fasting stomach is preferable either by introducing the tube directly into the stomach and aspirating, or else by withdrawing in the same manner a small quantity of saline solution previously ingested. Lavage may be employed, and the returned water examined. The latter method is not as desirable as the former because one has too large a quantity of water in which to hunt for the cells. The method employed by the author and the process of staining for them will be found elsewhere in the volume. In states of continued high secretion of the stomach where the mucus content is low ciliated columnar cells may be found in small numbers. The squamous cells are found generally in all test-meals and fasting stomachs; they are swallowed from the mouth, pharynx, or esophagus, and are of no significance. Ciliated columnar cells may be swallowed in mucus from the post-nares or trachea and are of no significance, excepting possibly in disease of these areas. Free nuclei from digested cells are common findings.

**Gastric Juice.**—The passage of a tube into the stomach excites a flow of small quantities of gastric juice. When this quantity is increased, as it may be up to 100 cubic centimeters, an anorectal secretion exists, such as is commonly observed in gastritis, rheumatism, gastric and duodenal ulcer, and the irritation of gall-stones and diseased appendix. In these examinations, the empty stomach is aspirated.

**Mucus and Saliva.**—These are commonly found in the fasting stomach, and are of no significance—excepting in alcoholic gastritis when considerable quantities of mucus may be obtained. In inflammatory conditions about the mouth and throat, mucus and saliva may be swallowed and found in the stomach. Mucus is readily recognized by its viscid character and appearance under the microscope, and saliva

its converting action on hydrated starch. These are obtained by dry aspiration, or after saline instillation. With the mucus is found epithelium and a few leucocytes.

**Bile and Intestinal Juice.**—It is well known that under certain conditions bile may find its way into the stomach. When this occurs its bilirubin is converted into biliverdin and the bile manifests itself as a yellow or green color. When it is present in large amounts, more or less intestinal and pancreatic juice usually accompanies it giving an alkaline reaction to the return; the latter depends upon whether gastric juice is also present and in what amounts. In my observations, bile is a not uncommon finding in the fasting normal stomach, although not so often as when severe gastric or general neurotic disturbances exist. Its diagnostic importance, therefore, should not be overestimated. When present, the pancreatic or true intestinal juices are rarely found in the amounts that the bile is, and when the latter is very small in amount, not at all. In obstructive states of the intestine, the presence of large amounts of bile, pancreatic juice, and succus entericus is often the first objective symptom of the condition. To obtain these aspiration either dry or after saline instillation is employed. In late or complete states of intestinal stenosis a light-brownish fluid with a mildly fecal odor can be obtained by washing the stomach, and this is succeeded by a darker fluid which has a stronger fecal odor.

**Blood.**—When hemorrhage produced by the passing of the tube can be excluded, blood in the empty stomach is always of significance. The blood caused by the tube is but very small in amount, is seen in streaks, and is bright red. Blood which is more or less changed, or thoroughly admixed with the gastric contents, is usually from the stomach itself (swallowed form excepted). Blood is found under the following conditions: gastric ulcer and cancer; rupture of congested or varicose veins; late in diseases of the heart, liver, lungs, etc.; and in menstruation or the blood dyscrasias. Its presence can usually be detected by the color, or the chemical tests (the occult form only in the latter way). Dry aspiration may be practiced, although aspiration after instillation is safer and more satisfactory. These examinations should never be performed when hematemesis is present, or the aspiration should be stopped as soon as the return manifests its presence. Leucocytes are also present with the red blood-cells.

**Pus.**—This obtained from the fasting stomach is of great significance in the early diagnosis of cancer and chronic ulcer. It is also present in phlegmonous gastritis, and is of much value in making a diagnosis of this rather difficult to diagnose affection. It is indicative

of ulceration or infection, and is best obtained by expression after instillation, centrifuging the return and examining the sediment by means of the microscope.

Other Findings.—Desquamated fragments of gastric mucosa and particles of tumor tissue are rarely observed, but should always be searched for and examined when seen. Yeast-cells and sarcinæ may be seen, and when yeast is present in large amounts the mucus spiræ are often present. Other types of mould fungus may be seen. Among these are those described by Einhorn.<sup>8</sup> Two varieties of protozoa (trichomonas hominis and the megastoma entericum) are occasionally met with in cancer, providing there is no HCl, an alkaline reaction pouches or folds in the gastric mucosa, and absence of food residues. Many Boas-Oppler bacilli are met with we are in all probability dealing with carcinoma of the stomach.

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- <sup>3</sup> BOAS: "Diseases of the Stomach," p. 138.
- <sup>4</sup> BASSLER: "Extracting Test-meals," New York State Journal of Medicine, June, 1908. (This apparatus can be purchased from Eimer and Amend, New York City.)
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- <sup>6</sup> BOAS: Centralbl. f. innere Medizin., 1896; and "Diseases of the Stomach," p. 98.
- <sup>7</sup> SAITO: Berliner klinische Wochenschrift, 1906, Nu. 40.
- <sup>8</sup> EINHORN: Medical Record, June 16, 1900; and "Diseases of the Stomach," p. 100.

## CHAPTER VII.

### Examination of Gastric Contents.

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Of essential value in the diagnosing of gastric affections are a working knowledge of laboratory technique, and the necessary apparatus, staining reagents, solutions, and so on to conduct same. In engaging in this, as well as for all clinical diagnosis work, the fitting up of a working laboratory is liable to error in one of two ways: Either the laboratory is too limited in appointment for complete enough work, or a great expense has been incurred to make it so and it is overburdened with unnecessary things. While the latter is hardly a fault, for those beginning a laboratory the high cost of laboratory equipment is often a factor that deters them from interesting themselves in this most necessary part of medicine; for a physician without a practical laboratory at his back is almost as badly handicapped as is a far-sighted person without his glasses. To do gastrointestinal work properly, in addition to those things suggested in the following pages for gastric analysis, must be added the means to carry out examinations of feces, blood, urine, sputum, and section examinations of tissue specimens. The latter entails considerable extra expense and time in the examinations, and the relatively few specimens obtained in the routine of work might make it desirable for such to be examined in a hospital or by others skilled in this work. In such instances, however, it is always wise to re-examine the section yourself so as to be convinced that the pathological report regarding it is correct.

#### MACROSCOPIC EXAMINATION.

The first step in the examination of test-meals is to determine the appearance, quantity, and odor. It is surprising how, after a short experience, one can fairly accurately diagnose many of the gastric disorders by the appearances that extracted meals present. Still, too much reliance should not be placed upon these macroscopic observations alone, and thus they should always be followed by the more positive chemical and microscopic tests.

An Ewald test-meal from a normal stomach may be described as of a dirty whitish-yellow color, the particles being in a good state of subdivision so that its gross appearance is that of well-cooked gruel

of very fluid consistency, from about 20 to 70 cubic centimeters in amount, and of a slightly acidulous, musty bread smell. The bread or roll crusts usually show darker and larger particles than the rest of the carbohydrate constituent. The stomach contents from a Riegel meal extracted from a normal stomach at the third or fourth hour interval is usually smaller in amount, somewhat more viscid than the above, somewhat darker in color, and either of about the same odor or the simple meal or else of no distinct odor at all.

In clinical work, a meal which corresponds with the above finding (euchlorhydria) may be seen in normal stomachs, in gastric neuroses in a few cases of chronic gastritis associated with atony, in the post-ulcer irritative conditions, in benign growths of the cavity of the organ, and in very early malignant disease.

In states of excess of gastric secretion the total return is usually higher, running between 70 to 120 cubic centimeters in hyperchlorhydria, and considerably over this in true gastrosuccorrhea. In diagnosing states of increased gastric secretion, the filtrate obtained from the test-meal serves as a better standard of measurement than the total return. Taking filtrates having the same proportion of HCl content (30° to 60°), it has been my custom to consider from 20 to 50 cubic centimeters as normal, from 50 to 100 cubic centimeters as a dietetic increase (hyperchlorhydria), and above 100 cubic centimeters as suggestive of a more or less continuous secretion (gastrosuccorrhea). The subject has to do with the total HCl in the quantity of filtrate obtained, and it must be plain that a filtrate of 50 cubic centimeters with a total HCl of 30° may be normal, while over 100 cubic centimeters of filtrate with the same degree of total HCl may be an excess secretion. Therefore it is, that the author advises reckoning the HCl content in the total filtrate, rather than decreeing states of excess or diminution of secretion on the acidity of a small amount of the filtrate obtained, and thus he gives the above standards in the estimations of same. The gross appearance of a simple meal in excess secretions (gastritis acida not included) is larger in amount of total return, and the bread substance is not as finely divided or homogeneous as in the normal. The increase of acidulous odor cannot be depended upon in diagnosis, since quite a bland and bread-like odor may be present and high acidity exist. When hypermotility is present with excess secretion, the return would be small in amount but the coarse appearance of the bread is not changed.

In low states of secretion (hypochlorhydria), the amount, odor, and appearance of the test-meal are not much changed from the normal, and, in fact, it is because these are so and the filtrate gives a low

total HCl reading (under 30°) and regurgitation of intestinal juice can be excluded, that such states can be diagnosed. Here again, the total filtrate should be the standard of consideration.

In the absence of gastric secretion (anachlorhydria, atrophic gastritis, achylia) when but little or no gastric mucus is present, the test-meal usually shows definite changes. The return is generally large in amount, and the bread quickly separates from the meal to the bottom, leaving a supernatant fluid which is clear and watery; thus, it resembles bread, water, and saliva which had stood for an hour. Such meals then are very fluid, and the carbohydrate content, when sufficient saliva has been swallowed, is well digested (excepting usually the crust). In fact, the best evidence of gastric carbohydrate conversion is seen in these meals, providing the achylia is not due to malignant disease. In the latter, conversion is not well advanced (probably due to the excess organic acids in these stomachs which is almost as deterrent to their conversion as is the HCl). When an atrophic gastritis exists, excessive mucus may also interfere with carbohydrate change, although here the meal is more viscid. In absence of stomach secretion, of non-malignant origin, the return smells exactly like bread.

In pyloric stenosis of marked degree, and particularly when this is due to malignant disease, the test-meal return is large in amount, dark in color (usually a coffee and milk color), and of a fetid odor. These meals on standing usually separate into three distinct layers—which have shades of the same color—and are composed as follows: the upper mucus and coarse particles of food; the middle, the largest, an opaque fluid; and the lower, the smallest, the carbohydrate substance. Such test-meals always mean marked fermentation in the stomach from pyloric stenosis and absent gastric juice secretion, and in rare cases, a high grade of gastric insufficiency—motor and secretory.

A reddish tinge to test-meals is suggestive of blood, although it may be due to certain red-colored foods and drinks; when observed, tests for blood should always be made. Bile gives to test-meals a yellowish or greenish color, and tests for its presence should also include those for the intestinal secretions.

Much mucus is readily observed with the naked eye. It is found in test-meals in two forms; that from the throat and mouth, which floats in thick clumps upon the top, and that from the stomach, which renders the meal viscid and can be recognized by putting a glass rod into the meal and withdrawing it sideways, when it will be noted that the mucus adheres to the staff. Pus is not observable with the naked eye in test-meals, but may be seen when present in considerable

amounts in aqueous instillations. Duodenal juice is also not visible and must be tested for.

Lastly, it should be mentioned that in intestinal obstruction and where communication exists between the stomach and intestine (usually the colon), a fecal odor is observed in the meals. Very commonly in test-meals extracted from alien Russians or Italians who use garlic and onion in large amounts, the aromatic substances of these vegetables may persist in an empty stomach and give their odor to the meal—even in the apparently normal stomach. In fetid conditions about the mouth, the swallowed contaminated saliva may give foul odor to stomach contents. Medicaments, such as valerian, etc., containing the aromatic oils, etc., when taken at the test-meal time or before then on the same day, may influence the odor; and thus medicament of any sort should be permitted to be taken until after the extraction of the meal.

#### **EXACT DETERMINATION OF THE CHYME WITHIN THE STOMACH.**

Properly done, the expression method can empty a stomach in the majority of instances, and the aspiration method in all—this, of course excepts particles of food that may be adherent to the mucosa, particularly about the rugæ. When, however, atonic dilatation or prolapse exists, there is always a doubt by simple expression that the stomach is surely emptied of its contents. These, with the instances in which kinking of the tube is troublesome (excessive and rather constant straining), or the chyme is too viscid to raise through the tube, make it important to have some method by which the total contents can be estimated. This can be done by the method described by Mathieu and Rémond, which is as follows, and which is of value only when the stomach contents are acid:—

At the proper time for extraction of the Ewald meal, the tube is passed, and as much of the gastric contents as possible is secured and set aside. A funnel and extra length of tubing are now attached to the stomach-tube, and about 200 cubic centimeters of water are run at one time into the stomach. The funnel is now lowered to below the stomach level, to allow the fluid to flow back into the funnel, which is later raised, then lowered, and so on, for a number of times until thorough admixture has taken place, after which the fluid is withdrawn. In flaccid abdomens or thin subjects, sharp taps upon the abdomen assist in the admixture, and where it is noticed that much carbohydrate matter is secured in the water, a second 200 cubic cen-

meters should be employed after the first has been drained out. We now have the first contents (test-meal), and the water from the one or two instillations, the acidities of which must be ascertained separately. The calculation proceeds as follows: If  $b$  represents the undiluted test-meal, and  $a$  the acidity of it; and  $q$  the quantity of water introduced, and  $a'$  the acidity of this, the acidities ( $a$  and  $a'$ ) must be indirectly proportionate to the quantities, because the greater the quantity of water instillation, the smaller the total acidity of the combined liquids obtained. Accordingly the following formula is obtained:—

$$ax = a'q + a'x$$

$$\text{which gives } x = \frac{a' q}{a - a'}$$

The quantity of contents originally contained in the stomach is then represented by the formula:

$$y = b + \frac{a' q}{a - a'}$$

or the original contents of the stomach are equal to the number of cubic centimeters of water instilled within the organ, multiplied by its degree of acidity, divided by the figure resulting by deducting the degree of this acidity from the first, plus the portion previously withdrawn.

#### REACTIONS OF THE STOMACH CONTENTS.

After the macroscopical examinations, the stomach contents are tested for reaction. For this purpose, S and S 18½ centimeter filter paper is used folded either in quarters, or better still, once through the middle and then at half-inch intervals from this until the entire paper is creased into twenty or more folds. The filter paper is placed in a glass funnel (preferably grooved) capable of holding about 200 cubic centimeters, which is supported on a wooden funnel-holder stand. The filtrate which is obtained, according to the condition, contains the gastric juice (plus a portion of the water content of the test-meal), the free and combined hydrochloric acid, the gastric enzymes and pro-enzymes, the acid salts, the products of carbohydrate conversion, the organic and volatile fatty acids, blood, bile, and intestinal secretions, ptyalin when the filtrate is HCl free, and a limited amount of the starch constituent, mucin, and some micro-organisms.

The chemical examination begins by withdrawing the receiving vessel containing the filtrate (which, by the way, had best be a small

Erlenmeyer flask), and permitting a drop of the filtrate to fall upon certain papers or into solutions used for the purpose of noting its reaction. This is to be preferred to plunging the testing papers into the unfiltered contents in the funnel, or directly into the filtrate in its container.

The most sensitive test for free hydrochloric acid is furnished by means of Congo red. This may be used as a solution, a small amount of which (5 cubic centimeters) is placed in a porcelain dish and a few drops of the filtrate dropped into it. In the presence of an acid, the color immediately changes from bright red to a blue depending in depth upon the strength of solution used and the amount of free acid present in the filtrate. In place of the solution, Congo red paper may be employed. This consists merely of a bibulous paper soaked in strong Congo red solution and then dried. Another way of quickly noting the reaction is by means of the time-honored blue litmus paper (turning red), which is not as sensitive as the first mentioned; or else neutral azolitmin solution, which tests both ways, may be used.

The above only test the reaction of the filtrate, that is as to whether it is acid or not, and do not differentiate between the free acids that may be present—hydrochloric or organic. Boas<sup>2</sup> has shown that Congo red will give the same depth of color with 0.3 per cent. of lactic acid as it does with a 0.1 per cent. of hydrochloric; and the same may be said of the red litmus. In routine work, however, one rarely meets with a filtrate containing lactic acid in amounts that will give more than a medium degree of blue color, and when a deep blue is obtained it is rare to find that the reaction is not produced by the stronger of the two, namely, hydrochloric acid. But it is always wisest to employ either one of the above reagents merely to note whether the filtrate is acid or not, and those mentioned below to differentiate the nature of the acid.

#### REACTIONS WITH HYDROCHLORIC ACID.

A large group of reagents may be utilized for this purpose, but those which act specifically with the mineral acids only will be considered. Hydrochloric acid being the only inorganic acid ever encountered in the gastric secretion (and in fact the only free mineral acid in the body), all positive results from these tests are due to this acid alone.

The first and by far the most sensitive of all testing reagents known is dimethyl-amido-azo-benzol, either in solution (0.5 per cent.), or saturated in bibulous paper and dried. Dimethylamidoazobenzol is a yellow powder which, in alcohol, forms a yellowish-pink

solution, or when used in the form of the popularly called "dimethyl paper" a yellow color. These when brought in contact with free hydrochloric acid strike a reddish-pink depending in depth of color more upon the amount of free acid present than upon the amount of reagent solution added. (Plate XLIX, Fig. 1.) Krukenberg<sup>3</sup> has found that this reagent will detect as small an amount as 0.002 mille of hydrochloric acid.

Another excellent reagent is tropeolin OO. This salt when dissolved in alcohol forms a yellowish-brown solution which an acid turns to a red. The organic acids also strike a similar color, but the distinction between these and hydrochloric can be made in the following manner: Three or four drops of a saturated solution of tropeolin are placed in a porcelain dish, and the solution is spread over its interior. Into this an equal amount of gastric juice is added, and the dish is again moved so as to thoroughly mix the two. If the dish is now gently heated over a small flame, lilac or blue stripes form at the edges which are positively due to hydrochloric acid, since no organic acids in any concentration can form them (Boas).

Another test which in my hands has proved most valuable is by means of the Günzburg reagent which is composed of:—

Phloroglucin .....	2.0
Vanillin .....	1.0
Absolute alcohol .....	30.0

This is a sensitive and most reliable test for free hydrochloric acid; organic acids, albumins, peptones, or acid salts do not interfere with it. When first made, the solution is yellow in color, which turns to a brown when exposed to light; therefore, it should be kept in a dark-colored bottle, and preferably freshly made before using. For this reason the method which Lenhartz has suggested is serviceable, namely, to have on hand separate solutions of phloroglucin and vanillin, 1 or 2 drops of each being employed in the test. This is simply accomplished by having a two to thirty phloroglucin alcoholic, and a one to thirty vanillin alcoholic solution, employing two drops of the first and one of the second. To this in a porcelain dish a few drops of the gastric filtrate or the unfiltered contents is added and slowly evaporated, when, if 0.05 per mille or more of free hydrochloric acid is present, a general rose tint or rose-colored lines develop. (Plate XLVIII, Fig. 1.) This color remains when the dish is cool. One must be careful not to heat the dish too rapidly or burn its contents since a confusing brownish-red color will be obtained. For this reason it is best when heating to hold the dish some distance above the flame, and to blow into it

occasionally to prevent overheating and to hasten evaporation; or we can protect the containing dish by a second one under it, and apply the heat to the latter. Phloroglucin-vanillin test paper can be purchased or made, but is not as reliable or sensitive as the reagent itself.

The Boas reagent, the so-called resorcin-test, is also to be recommended. It possesses the advantage over the above of greater stability and is equally as delicate and reliable. This reagent is composed of:—

Resorcin resublimate .....	5.0
White sugar .....	3.0
Alcohol (94 per cent.), dilute .....	ad 100.0

The test is performed by treating five or six drops of gastric filtrate with three to five drops of the reagent and slowly evaporating to dryness over a small flame, when a rose or vermillion-red color will be seen if free hydrochloric acid is present, but not so with the organic acids, acid salts, etc. The color disappears on cooling. (Plate XLVIII, Fig. 2.)

Comparing the above tests it may be said that the dimethyamidoazobenzol (Töpfer's) is the most sensitive, fades out in time, and may give a red color with the organic acids when these are present in large amounts—such as 0.5 per cent. of lactic (such large amounts of organic acids are rarely encountered in gastric filtrates). That the phloroglucin-vanillin (Günzburg's) and resorcin (Boas') are the most reliable tests for free HCl when this is present in amounts over 0.05 per mille—since they are not affected by any of the other constituents of gastric filtrates. That tropeolin OO is the least sensitive, requiring 0.3 or more per mille of HCl to produce the reaction, and that the color obtained must be differentiated from that of the other acids. And lastly, that Congo red and red litmus merely denote that the filtrate is acid in reaction without specifying whether this acid is mineral or organic in nature.

#### QUANTITATIVE ESTIMATION OF HYDROCHLORIC ACID, AND TOTAL ACIDITY.

The free hydrochloric acid appears in the gastric contents after all basic affinities have been saturated. During the early process of gastric digestion such HCl as has been secreted unites with the albuminoid and basic substances of gastric contents and is present in a combined state with them, and tests for the free acid are usually negative or the estimations are very low. Therefore it is that the mere presence in small amounts or the absence of free HCl does not permit

PLATE XLVIII.

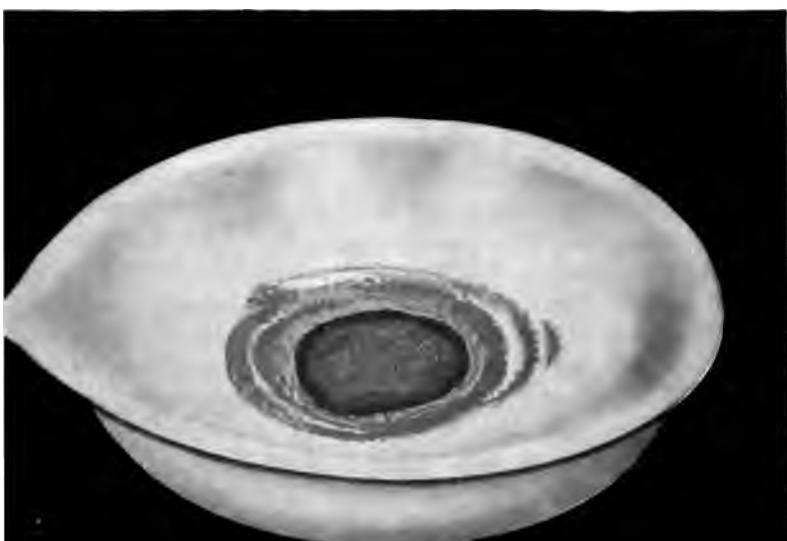


FIG.1.

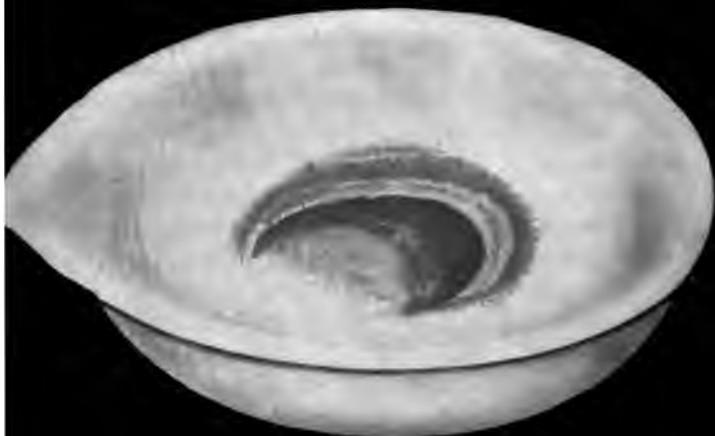


FIG.2.

Fig. 1.—Phloroglucin-vanillin test. (Günzburg's reagent.)

Fig. 2.—Resorcin test. (Boas's reagent.)



to infer that errors of this secretion exist, unless such estimations are made from contents removed at the height of gastric digestion.

In stomach contents removed at this time so much basic affinity may exist for saturation that a low free HCl estimate may be noted, and then, when the total HCl—free and combined—is estimated, a normal HCl secretion is manifested. On the other hand, these basic affinities may be so slight that free HCl is present in a large amount at an early period.

In the normal human stomach the hydrochloric-enzymotic secretion of gastric juice is usually greater in amount than the saturating requirement of the proteid contents. That is to say, the normal stomach secretes hydrochloric acid in excess of the amount necessary to saturate even a mixed meal. This provision of nature insures enough gastric secretion to meet the demands of the stomach contents to the very end of gastric digestion, supplies enough free HCl to stimulate the duodenal secretions for intestinal digestion, and probably also to maintain the normal pyloric reflex which presides over the opening and closing of the valve for foods. A mixed meal extracted in two or three hours may show a low free hydrochloric acid content, but a very large amount of acid combined with a large amount of proteid, while the same stomach after a simple meal extracted in one hour may give about as much free as combined acid—because of the relatively lower proteid content of the cold breakfast. It is upon the acid secretion running too high in amounts (usually represented in the free acid) that diagnoses of increased secretion are made, and for this reason the quantitative estimations of the total hydrochloric acid contained (free and combined) are important.

All authorities have agreed that the amount of hydrochloric acid varies between 0.1 and 0.22 per cent. Added to this in all meals is an organic acid content which is also present in both free and combined states, and a phosphoric acid content which is represented as acid phosphates. The following table of the acid from an Ewald meal is offered:—

Hydrochloric acid	$\left\{ \begin{array}{l} \text{Free.} \\ \text{Combined (with albuminoids, basic substances).} \end{array} \right.$
Organic acid	$\left\{ \begin{array}{l} \text{Lactic} \\ \text{Butyric} \\ \text{Acetic} \end{array} \right\} \text{Free.}$
	$\left\{ \begin{array}{l} \text{Lactic} \\ \text{Butyric} \\ \text{Acetic} \end{array} \right\} \text{Combined (with albuminoids, basic substances).}$
Phosphoric acid	—combined (with albuminoids, basic substances).

**Fractional Test-meal Extractions.**—With the introduction of the stomach-tube and its rapid adoption by the profession at large, much information in the pathological chemism of the stomach was obtained. In 1895 Schuele<sup>4</sup> published an article on the secretions and motility of the normal human stomach as observed by means of a catheter which he

left *in situ* throughout the cycle of digestion, thus simulating a gastric fistula. He was able to demonstrate the curve of acid secretion and actually ascertain many facts pertaining to secretion and motility on diets of carbohydrates, fats, meat, etc. Ehrenreich's<sup>5</sup> careful and accurate observations by means of a gastric catheter, withdrawing specimens by aspiration at frequent intervals, plotting curves of acid-ferment secretions, making note of the regurgitation of duodenal contents in normal and pathological cases, determined the effect on secretion and motility of the introduction of eggs, milk, etc. Further observations and communications did not occur until Rehfuss and his collaborators<sup>6</sup> appeared with a series of articles in which a special tube was used and by frequent aspirations he was able to plot curves of acid and ferment secretion, ascertain the emptying time of the organ, secretion of mucus, etc. These observations of Rehfuss are of the greatest practical importance and bid fair to offer a method to study gastric secretions far more complete and accurate than the single test-meal method of Ewald. Rehfuss proved that our idea of the gastric content of the normal human stomach was erroneous. It was believed before that over 20 cubic centimeters of fasting fluid was pathological but Rehfuss demonstrated upon apparently healthy medical students that amounts of 30 to 120 cubic centimeters were normal, approximately 50 per cent. of these contained bile and trypsin regurgitated from the duodenum. He further established three types of secretory curves as normal, namely the isosecretory, the hypersecretory or continued secretory, and the hyposecretory curve, depending on the rapidity of the acid secretion, height of acidity attained, and maintenance of the acid crest to the end of the digestive period. Further studies with the fractional method of gastric analysis proved that there is unquestionably no fixed standard of normal digestion but that different stomachs even when normal possess different gradients of function, some of them being normally fast and some normally slow. It must be apparent that under the factor of secretion is the still more important one of motility because in the instance of a slowly evacuating stomach the acid curve would be higher than in one which evacuated quickly. Thus it is in all secretory estimations this factor must be considered primarily.

We must realize that gastric digestion is simply a changing series of cycles, that in the normal individual these cycles succeed one another (digestive cycles) in response to the ingestion of food these again being succeeded by interdigestive or rest cycles. The chemistry of these two cycles, the digestive and interdigestive is totally different. The fasting stomach shows phenomena totally different from the digesting stomach as to the type and quantity of secretion, the total and free acid figures, the amount of regurgitation, etc. One thing is clear, the stomach is never

at rest, and there is always to be found in that organ in health an active secretion.

The technique followed by me and which has been found most useful in a clinical way is rather a combined method. During the afternoon or the morning before the examination is made, an enema is given for the purpose of clearing out the lower bowel. Since there is so much constipation in individuals who have digestive disturbance, this has proven to be a practice worth while. Often where there is much feces in the lower intestinal canal, the secretory curve may be different from the curve obtained when the bowels have been properly moved. At midnight the night before, several raisins or prunes are eaten, because often in states of pyloric obstruction these skins may be met with in the stomach the next day. During the course of the morning the tip of the Rehfuss tube is swallowed, if possible, without water to assist it downward. When water is used, only a measured amount is employed so that this can be figured in the aspiration which is begun immediately the tip of the tube is *in situ*. Aspiration is then made with the individual in the prone and upright position, the stomach being "sucked dry." The aspirate obtained is examined for the purpose of figuring out the secretory residue in the stomach when empty, whether raisin or prune skins are present and the status of acidity. If water is used in the swallowing of the tube this is made note of in the chemical estimation. The stomach being dry, the Ewald test-meal is taken. Sometimes where there is difficulty in eating the bread with the tube in the mouth; it is saturated and mixed in the proper amount of water and drunk. Every fifteen minutes thereafter, 10 to 15 cubic centimeters of the contents of the stomach are aspirated for examination, these aspirations being continued until the stomach becomes empty. Titrations of the various specimens are carried on in the usual way with a decinormal sodium hydrate solution and estimated on the basis of per 100 cubic centimeters of stomach content. The stomach usually empties itself in about two and one-half hours. In hypersecretory cases, the total acidity reaches slightly higher levels, for the acidity is slower and does not approach the base line free if at all. In the hypo-secretory type there is noted as in the isosecretory that the acid does not rise above 50°.

What must be apparent to the reader is that this method of gastric analysis presents advance beyond the one-hour test-meal extraction and that it is well worthy of universal adoption. It must also be remembered that all gastric analysis is merely an expression of motor and secretory functions of the stomach together with obtaining such pathological findings in a meal which have their clinical suggestions. Test-meal extraction cannot give any information as to the anatomy, contour and de-

formity of a stomach, these being best noted by roentgen-ray examination. It must also be remembered that since stomachs even in the

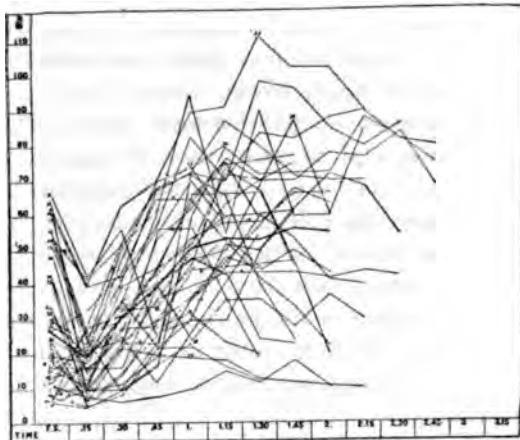


Fig. 40.—The total acid curves in thirty-eight gall-bladder cases (operation in thirty-four). Note the low acidity of the fasting condition (F. S.), the prompt response, the fairly constant time of maximum acid and the early emptying time at or near the high point. The gastric cycle incomplete. In this and the following charts the heavy line represents mean acid curve and terminates at the mean emptying time. (Horner.)

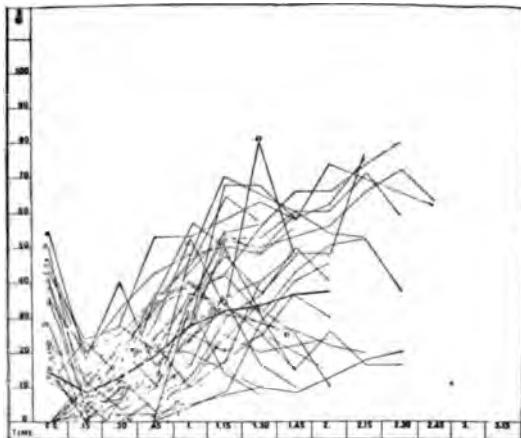


Fig. 41.—The free acid curves in thirty-four gall-bladder cases (anacid curves not shown). Note the tendency to empty early at the peak point. (Horner.)

individual differ so markedly in their function, unless the type of disease was known it would be quite impossible to deduct wisely any change in the acid curve plotting. Much has been written

ten said that definite curves represent this or that disease, mostly those referred from the gall-bladder, appendix, etc. The author has

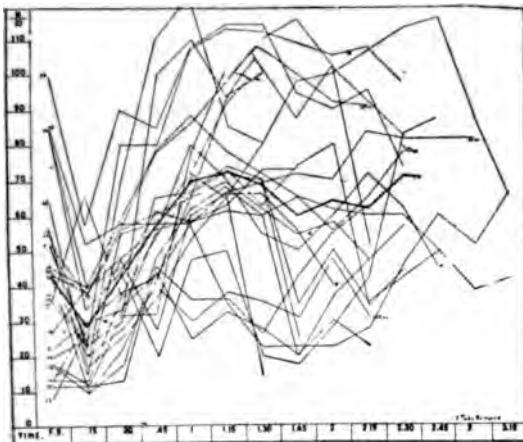


Fig. 42.—The total acid curves in twenty-six duodenal ulcer cases (with operation in fifteen). Note the extremes of acidity of fasting content, the prompt secretory response to food stimulus, the high acidity, and the delayed emptying time. (Horner.)

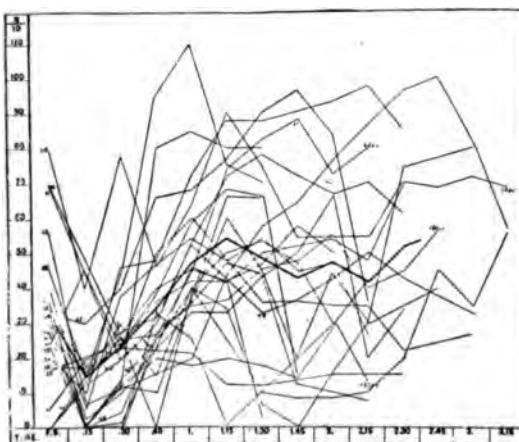


Fig. 43.—The free acid curves in twenty-six duodenal ulcer cases (with operation in fifteen). Note the prompt secretory response, the high free acidity, and the delayed emptying time. There are no anacid cases in this group. (Horner.)

seen almost every variety of acid curve in referred stomach conditions (reflex) from whatever source, but in the same conditions they are only suggestively identical. It is true that fairly constant character-

istics of curves are noted in various diseases. In gall-bladder the secretory response is usually prompt with a high acidity a should not be forgotten that absence of acidity is not unmarked pathological disease of the gall-bladder. Very often conditions the emptying time occurs at or near the high point. ulcer carries generally a prompt gastric response, a rather high and delayed emptying time. In ulcer of the stomach itself, no the pylorus, there may be a weak and delayed response, a acidity, and an early emptying time. In gastric carcinoma one two extremes, the first showing the presence of acid and :

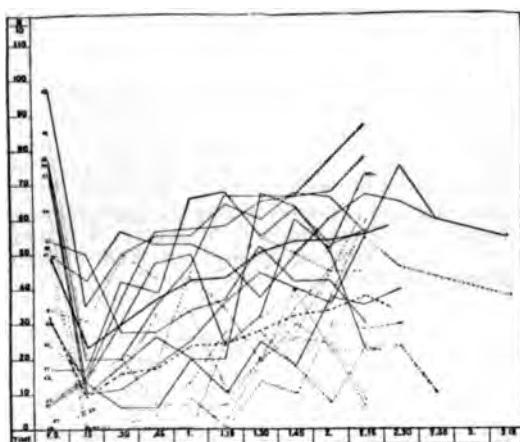


Fig. 44.—The fractional test meal curves in ten gastric ulcers (with operation in eight). Total acid is indicated by the continuous line; free acid by the interrupted lines. Note the high acid values of the stomach content as compared with that obtained in the curves, the and weak secretory response, the moderate height of curves, and the uniform emptying time (seven cases at two and one-fourth hours) (Horner.)

emptying time, and the second showing the absence of acid and emptying time. Nevertheless, the fractional test-meal method the clinician in estimating the amount and character of fasting content, the gastric response to foods, the acidity, the amount after of secretion, the degree of gastric digestion, the presence the amount of bile, incidence of pain at any specific point in the cycle, and the best method in a test-meal way of noting motility the emptying time of the organ far better than the old one-hour portion of Ewald. After one has become familiar with deducting curves, far more diagnostic values are obtained than was possible old way.

**Töpfer's Method.**—The free and combined hydrochloric acid and the total acidity are most conveniently estimated by this method, which is both simple and accurate enough for ordinary clinical purposes. The method determines the acid factors separately by the use of three different indicators; the free hydrochloric acid and the total acidity are estimated directly, and the combined hydrochloric acid indirectly. The solutions employed are:—

1. A 0.5 per cent. alcoholic solution of dimethylamidoazobenzol.
2. A 1 per cent. alcoholic solution of phenolphthalein.
3. A saturated aqueous solution of alizarin.
4. A decinormal solution of sodium hydrate.

No. 1 is used to estimate the amount of free HCl; No. 2 the total acidity (free and combined mineral and organic acids); No. 3 the amount of free HCl, free and combined organic acids and phosphates—all acidities excepting the combined HCl which is figured in amounts from the result noted by that obtained with No. 2; and No. 4 is a standard alkaline solution used to neutralize the gastric filtrate.

The author's technique of procedure is as follows: 5 or 10 cubic centimeters (preferably 10) of gastric filtrate are placed in a porcelain dish 9 centimeters in diameter. Into this are put two drops of the dimethylamidoazobenzol solution which causes the filtrate to turn a red color in the presence of free HCl. Titration with the decinormal lye solution is now carried on until the reddish tone disappears and gives place to a canary-yellow (Plate XLIX, Fig. 1). The end reaction is a yellow tinged with green and not a yellow wherein some of the lurking red tone is evident. The quantity of alkaline solution used is now noted, and, with the subsequent analyses, figured as below. The next step is to estimate the total acidity. For this, the same filtrate can be used, or a new portion employed. One or two drops of phenolphthalein solution is now added (which does not change the color), and titration is continued until a permanent pink is obtained (Plate XLIX, Fig. 2). Care must be taken that the end reaction of this is carefully performed. The term "permanent pink" means the point at which the addition of an extra drop of lye solution does not deepen the red color of the solution as a whole, and not the first permanent pink tint that the entire filtrate assumes before the end reaction is reached or the red color surrounding the drop of lye solution before it is mixed with the filtrate. To properly gauge this it is wise to let the last drops of the burette solution fall upon the side of the dish or add them to the filtrate by means of a glass rod. The quantity of lye solution employed is now noted and added to the amount employed to neutralize the free HCl—to give the

total acidity—or, if a second quantity of filtrate has been used, the total amount that was used.

The next step is to estimate the quantity of combined hydrochloric acid. For this a new portion of filtrate is necessary, to which three or four drops of the alizarin solution are added—the reagent being a dark-brown solution, usually changes the filtrate slightly to that color. Titration is now carried on through the free HCl, the free and combined organic acids, and the acid phosphate. As this proceeds, filtrates from different stomachs differ in the play of color observed. Some will pass through a reddish stage, some through a burnt carmine, and others again through a purple lake. The end reaction is always the first appearance of a pure violet color (Plate XLIX, Fig. 3). The amount of alkaline solution employed to obtain the purple, subtracted from the amount employed to neutralize the total acidity in the second instance, will represent the amount of combined hydrochloric acid the filtrate contains, and this estimation added to that of the free HCl gives the total hydrochloric acid content. These estimations can be made in another order—that is, first the total acidity, then the free HCl, and lastly the combined HCl. The first routine I have outlined is the better, however, since in the latter way three separate portions of filtrate are necessary, and the test-meal return when filtered may be too small in amount to permit of complete analyses by the latter method.

A liter of normal solution of hydrochloric acid contains 365 grams of hydrochloric acid, and thus each cubic centimeter of decinormal solution of sodium hydrate would correspond to 0.00365 of hydrochloric acid (remembered by 365 being the number of days in a year). It is required to figure from the number of cubic centimeters of lye solution used to neutralize the 5 or 10 cubic centimeters of the filtrate the corresponding amount that is represented in 100 cubic centimeters of each—that is, 20 or 10 times the amount of filtrate and alkaline solution, and thus the quantity of lye solution employed must be multiplied by these latter figures. For instance, assuming that 10 cubic centimeters of filtrate are employed, to which 3 cubic centimeters of lye solution represent the free HCl, 7 cubic centimeters the total acidity, and 4 cubic centimeters the alizarin reaction, the result in hundreds would then be the following:—

Free hydrochloric acid.....	30 degrees
Combined hydrochloric acid .....	30 degrees
Total HCl .....	60 degrees
Total acidity .....	70 degrees



ead of degrees we wish to represent the quantities in per-  
cent figures thus obtained are multiplied by 0.00365. Taking  
for example, the total HCl of 60 multiplied by 0.00365 = 0.219  
is physiologically active hydrochloric acid.

These examinations a graduate of small size, preferably the  
form of 10 cubic centimeter capacity, or a volumetric pipette  
in like amounts, is required to measure the filtrate, and some  
burette to measure the quantity of lye solution delivered into  
it; the latter named apparatus employed, the hand or stand

10 cubic centimeters capacity  
will. Care must be exercised with  
burette that the finger holding the  
the tube is dry or the lye solution  
delivered steadily. The objection  
to the hand-sized stand burette is that a funnel  
is required to fill it, and, as it is desirable  
not too much contact of air with the  
lye solution (soda carbonate forms),  
the automatic form is an advantage  
when estimations are being made.

In past years a number of other  
methods for estimating hydrochloric acid  
have been advanced. Among  
these may be mentioned the method of  
Lüttke,<sup>7</sup> Leo,<sup>8</sup> Hayem-Winter,<sup>9</sup>

All of these require a greater ex-  
penditure of time and a more complete labora-  
tory and are rarely necessary. Still,  
hydrochloric acid is present in very small  
amounts and absent by the usual tests, the  
method of Martius and Lüttke or Hayem-  
Winter would be of value since at these times  
there exist in the obtaining of the biuret  
and peptones. Of the two, I prefer the Hayem-Winter method.  
This method has been successful in detecting the presence of secreted  
hydrochloric acid in considerable amounts in many cases which have been pre-  
dicted as "achylia gastrica." This is particularly interesting  
since it considers that such a complicated procedure is apt not to be  
so liable to decompose the hydrochloric acid present in gastric contents and form free hydro-  
chloric acid. I believe that there are instances of a low hydrochloric acid  
content herein its very small amounts under certain conditions (of

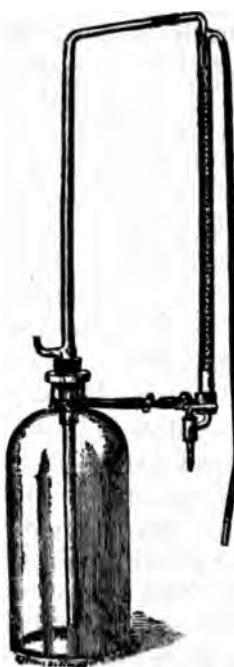


Fig. 45.—Automatic burette.  
Squibb's latest form.

gastric fermentation possibly) cause an intimate union with the organic substances, and that these are not detected by the Töpfer reagents and too indistinctly so for practical deduction by the biuret reagent.

**Hayem-Winter Method.**—By the method of Hayem and Winter the chlorine, which in gastric contents is partly fixed by combination with bases as salts and partly present as hydrochloric acid, is determined in two separate estimations. In the first, all the chlorine is fixed by the addition of sodium bicarbonate and is then measured; in the second, the addition of sodium bicarbonate is omitted so that in the process the chlorine of hydrochloric acid escapes and only the originally fixed chlorine is determined. The difference between these two results gives the quantity of chlorine present as hydrochloric acid, including both the free and the organically combined. It will be noticed that the author mentions but two steps in the procedure while that of the complete method as advanced by Hayem and Winter has three. My reason for this is, that I have found that the method for estimating the amount of free HCl is not to be relied upon, and for qualitative analysis the Günzburg test is more satisfactory. What concerns us particularly is, has hydrochloric acid been secreted, and if so, in what amounts? Therefore, only the first and last steps are of importance. This method is conducted as follows:—

1. *Total Chlorine (fixed and hydrochloric acid).*—Accurately measure 5 cubic centimeters of the gastric filtrate into a small porcelain dish and add about 2 cubic centimeters of a solution of sodium bicarbonate (enough to more than neutralize any acidity). Evaporate to dryness, preferably on a water bath, and thoroughly ignite over a flame avoiding heat that will produce more than a very dull redness. When cool, extract with boiling hot water, slightly acidifying with nitric acid, and filter, repeating the process till the filtrate is free from chlorine (no turbidity when a drop of silver nitrate solution and nitric acid are added to a half inch of the filtrate in a test-tube). To the filtrate washings, which should be clear and colorless, add an excess of calcium carbonate and heat the mixture to drive off free carbon dioxide. About 2 cubic centimeters of a 3-per-cent. potassium chromate solution are added and the mixture titrated with decinormal silver nitrate until a faint but permanent red coloration is produced. The number of cubic centimeters of silver nitrate solution used multiplied by 20 gives the degrees of the total chlorine present (expressed in terms of acidity).

2. *Fixed Chlorine.*—Proceed as in (1) omitting the addition of sodium bicarbonate. The number of cubic centimeters of silver nitrate

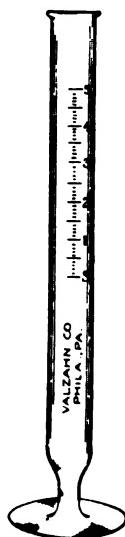
employed in the titration multiplied by 20 gives the degrees of the fixed chlorine present (expressed in terms of acidity).

The chlorine present as hydrochloric acid is found by subtracting 2 from 1. The difference is the hydrochloric acid expressed in degrees of acidity. This is the total quantity of hydrochloric acid as such in the gastric contents, and accordingly represents what has been secreted by the stomach.

Considering now, as Kossler<sup>10</sup> has suggested, that by this method less chlorine is to be found in the residue than was originally present in the gastric contents, then the instances in which I have obtained differences in results between 1 and 2—and particularly when the gastric proenzymes are also present—must mean gastric juice secretion, even if the simpler method gives negative results in the hydrochloric acid estimations.

For quick clinical work, such as may be desirable in dispensary practice in the average case, the so-called "acidometer" may be used for estimating the amounts of free hydrochloric acid and total acidity—but not the combined or the total HCl. The use of this graduated cylinder is also of value when only small amounts of filtrate are obtained so that dilution of it with distilled water may be necessary to make the quantity of fluid large enough for estimation. Patterned after the Citron instrument, Raue<sup>11</sup> has devised an instrument which possesses the advantage of having a stand and fewer graduations. The method of procedure is as follows:—

The acidometer is filled with gastric filtrate to Fig. 46.—Acidometer of S, a drop of dimethylamidoazobenzol solution and Dr. Raue.  
decinormal solution of soda hydrate added until the end reaction of the free acid is obtained (yellow). Now read off the amount of alkaline solution used by consulting the graduations, and the amount multiplied by 20 represents the free HCl content. The next step is to add a drop of phenolphthalein and continue dropping the lye solution until the end reaction of this is reached (permanent pink); the amount used is now noted, and multiplied by 20 to obtain the total acidity. Agitation of the tube is necessary after each few drops of lye solution are added. As S marks 5 cubic centimeters, if only 2 cubic centimeters of gastric filtrate are used and water to the mark is added, the results are multiplied by 50 instead of 20. At these times the depths of colors will be correspondingly lighter.



The clinical significance of hydrochloric acid estimations, as well as the following in this chapter, will be found in connection with the various gastric disorders.

### ORGANIC ACIDS.

The organic acids found in the stomach are lactic, butyric, and acetic; the latter two, representing the volatile fatty acids. Two kinds of lactic acid are found in the stomach—that formed as a product of fermentation of the carbohydrates under the action of bacteria (ethylidene), and sarcolactic acid which is ingested with the meats. As only the fermentative lactic acid—that formed in the stomach—possesses special interest in the diagnostic way, only this will be considered.

**Lactic Acid.**—Boas' researches have shown that under normal conditions the amount of lactic acid formed during the process of digestion is not present in easily recognizable amounts, and that certain breads and meat foods can introduce it from without. Therefore it is essential, when the acid is found present in the stomach, that a test-meal be employed which is lactic acid free. For this purpose he has advanced the lactic-acid-free meal (described in this chapter), given in the morning after a thorough lavage the evening before. In the average case, small amounts of lactic acid formed after the Ewald test-breakfast may usually be disregarded, but when this is present in easily recognized amounts the Boas meal should always be employed since at these times the acid is usually of pathological significance. This is seen in stagnant conditions of the stomach and when the gastric juice secretion is very low or absent. Hence, it commonly observed in gastric carcinoma, motor insufficiency, and also in the benign pyloric stenoses when these cause a marked degree of obstruction (although some lactic acid may be found in those few instances of normal stomachs which have always been anachlorhydric). It is a particularly common finding in gastric cancer, and in early stages of this disease its occurrence with a diminution of the gastric juice secretion (represented as HCl) is of much value in making an early diagnosis. It must always be remembered that in cancer, lactic acid only appears because of the dual conditions of disappearance of secretory function, a motor failure—the latter either because of pyloric obstruction, or atony, or both together. Therefore, should the cancer be under an ulcer, mostly extra gastric in location, it may not be a feature in the condition until very late, and even then in some cases not at all. Since it is present normally in the test breakfast and in the mixed meal (because of t

meat) it is a common finding in small quantities, and in my experience, in primary atony and chronic gastritis often in fairly large amounts. Quantitative tests for lactic acid are rarely necessary. It is sufficient for practical purposes to remember that when the chemical reactions for it are conclusive, lactic acid is present in amounts of 1 pro mille or over, and that such is of pathological moment.

**Uffelmann's Test.**—In my hands the Uffelmann test is the least reliable of all clinically employed methods, because—even with the intervention of ether—as much as 1 per cent. of lactic acid may not give the reaction, and that hydrochloric and butyric acids and phosphates (commonly present in test-meals) and alcohol give somewhat the same reaction as lactic acid. Thus, when in doubt, no reliance should be placed upon results observed, unless at least extraction by ether has first been performed.

To this end the gastric filtrate is first tested with Congo-red to note whether it is acid or not. If the reaction is negative, dilute hydrochloric acid is added until the Congo test is just positive. The object of this, as Simon has shown, is, that if lactic acid is not present in a free state, but in combination with albumin, the HCl is necessary to free it or it will not be extracted by the ether. Five or 10 cubic centimeters of filtrate are extracted with about ten times the quantity of neutral sulphuric ether (in a separating-bottle) for about 20 minutes. In a short time the ether extract is separated and evaporated on a water bath. The residue is now diluted with distilled water up to the original amount of filtrate employed, and this is added to the reagent. It is best to add the aqueous solution cautiously in lots of about 1 cubic centimeter so that it remains at the top of the reagent; in this way a fair idea of the amount of lactic acid may be gained.

The testing solution (always freshly made) consists of a test-tube almost filled with a 2-per-cent. aqueous solution of carbolic acid, to which a drop or two of ferric chloride solution had been added. The completed reagent has an amethyst-blue color the depth of which depends upon the amount of iron solution added (this color should not be deeper than a plainly evident amethyst-blue). To this, the filtrate extract described above or the unevaporated ether described below is added, and in the presence of 1 or more per cent. of lactic acid, a canary-yellow color is obtained (Plate L, Fig. 1).

Instead of evaporating the ether as above described, the ethereal extract may be added directly. For this purpose the employment of the Strauss separating bottle is handy and permits of roughly determining the amount of lactic acid present. Into the instrument shown here, 5 cubic centimeters of the filtrate are placed and ether added to

the 25 cubic centimeter mark, and, after shaking thoroughly, the apparatus is held upright until the ether separates, the cock is then opened and the gastric filtrate permitted to run out until the lower ether line reaches the 5 cubic centimeter mark. The 20 cubic centimeters of ethereal extract remaining in the separating bottle can be used for the Uffelmann test, either by first evaporating to 5 cubic centimeters, or in its entire quantity. Evaporation is easily accomplished by running the contents of the bottle into a test tube which is placed in a glass of hot water. Partial evaporation is always preferable to employing the entire amount.

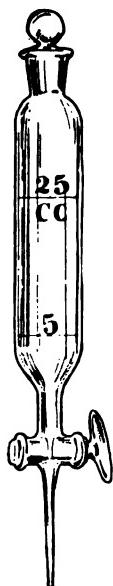


Fig. 47.—Strauss separating bottle used in making quick quantitative estimations of lactic acid.

**Strauss' Method.**—Ordinarily, only large amounts of lactic acid are important from a diagnostic standpoint. Therefore, the method suggested by Fleischer and perfected by Strauss is most practical and quick to perform. For this, a Strauss separating apparatus is filled with gastric juice to the mark 5, when ether (free from alcohol) is added to the 25-cubic centimeter line. After shaking thoroughly, the separated gastric filtrate is allowed to run out until the lower level of the ether extract is at the 5-cubic centimeter mark by opening the stop-cock below. Distilled water is now added from above to the 25 c.c. mark, and the mixture treated with 2 drops of the officinal tincture of ferric chloride diluted in the proportion of 1 to 10. Upon shaking, if more than 1 pro mille of lactic acid is present, an intensely green color is obtained, and a lighter green if there be less lactic acid than this. The author advises the use of this method as a routine in clinical work, for by it, not only can we be sure that we are dealing with lactic acid, but the amounts of it can be estimated closely enough for clinical purposes.

**Kelling's Test.**—To Kelling<sup>13</sup> belongs the credit of advancing the most delicate and also the simplest test for lactic acid in gastric filtrates. As advanced by this observer, the gastric filtrate is diluted (in a test tube) ten or twenty times its volume with water, and this is treated with one or two drops of a 5-per-cent. ferric chloride solution. As in the Strauss method (which was advanced after Kelling's, but which employs an ethereal extract) a greenish color with transmitted light shows the presence of lactic acid. This test will react to lactic acid in dilutions of 1: 10,000 to 1: 15,000. Simon<sup>14</sup> has modified this test by adding the gastric contents to the dilute iron solution, and employing a control to observe

PLATE L.

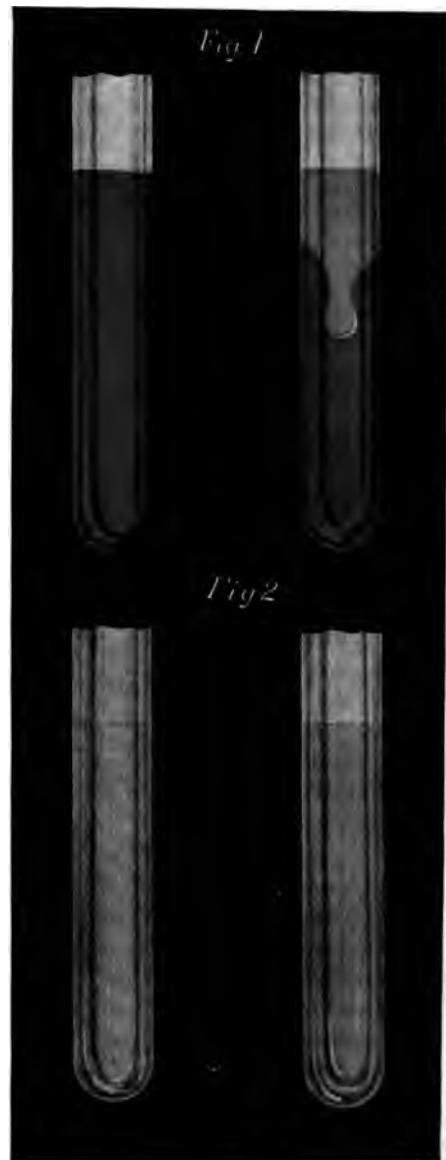


Fig. 1.—Uffelman's test for lactic acid.

Fig. 2.—Kelling's test for lactic acid. (Simon's modification.)



color change. The test is carried out as follows: In a test tube of filled water one or two drops of ferric chloride solution is added, so as barely color the water. One-half of this is poured into another test tube of the same caliber and serves as a control. A small amount of gastric filtrate is added to one of the test tubes, when in the presence of lactic acid a distinct yellow color develops at once, which appears more marked when compared with the control (Plate L, Fig. 2). This change of color can usually be observed by transmitted light, but when doubt is best seen by taking the tubes into a strong light and looking on through the solution, when a positive reaction will be noted as a darker brown than the control. In experimenting with this method of filtrates containing different percentages of lactic acid, I have observed that with 3 cubic centimeter quantities of filtrates containing respectively  $\frac{1}{4}$ , 1, and 4 per cent. of lactic acid the same depth of yellow is always produced in 15 cubic centimeters of water and one drop of iron solution; therefore in these percentages the depth of color observed cannot be employed to note the percentage of lactic acid present. On the other hand, to show the delicacy of the test, a definite reaction can be produced with 3 cubic centimeters of filtrate containing only .0015 per cent. of lactic acid. From the latter it will be observed that in a positive reaction with 3 cubic centimeters of filtrate in 15 cubic centimeters of water (making up the reagent), at least .0015 per cent. of free lactic acid is present, and as less gastric filtrate is employed in successive tests a fair idea of percentage is obtained. As an instance, a definite reaction is just about procured in the above mentioned amount of reagent, by 3 drops of a 1-per-cent., 1.5 drops of a 2-per-cent., or 1 drop of a 3-per-cent. solution of lactic acid.

Gastric filtrate containing more than 3 per cent. of lactic acid can be diluted with water and the result figured accordingly. It must however be mentioned that in this rough method of estimating percentages, not the definite yellow color produced in the perfect reaction is considered, but only a yellow which is distinct enough from the control that when the tube is shaken it is plainly noticeable.

**Boas' Rapid Method for Quantitative Estimation of Lactic Acid.**—This method possesses an advantage over the more complex one adduced by the same author,<sup>15</sup> in that it takes less time, does not require the various reagents necessary in the longer method, and is sufficiently accurate for clinical purposes. Ten cubic centimeters of gastric filtrate in a test tube is treated with a few drops of dilute sulphuric acid and heated and filtered to remove the albumin. The filtrate is evaporated to a syrup on a water bath, water added to the

original amount, and this is again evaporated to a small volume ~~to~~ remove the fatty acids. The lactic acid remaining is now extract ~~ed~~ with 200 cubic centimeters of ether, the ether is evaporated, the ~~resi~~ due taken up with water, and titrated with a  $\frac{1}{10}$  normal solution of sodium hydrate, using phenolphthalein as an indicator. As 40 parts by weight of sodium hydrate combine with 90 parts by weight of lactic acid, and as 1 cubic centimeter of  $\frac{1}{10}$  normal solution of sodium hydrate contains 0.004 gram of sodium hydrate, the corresponding amount of lactic acid is found from the equation:—

$$40.90 : 0.004 : x : 40; x = 0.360; x 0.009.$$

or 1 cubic centimeter of one tenth normal solution of sodium hydrate corresponds to 0.009 of lactic acid.

By multiplying the amount of cubic centimeters of lye solution used by this figure, the amount of lactic acid present in 10 cubic centimeters of gastric filtrate is ascertained and the result multiplied by 10 indicates the percentage. In this method, a part of the lactic acid escapes with the heating and evaporation and thus the figure obtained is usually slightly short of the actual amount the gastric contents originally contained.

#### VOLATILE FATTY ACIDS.

When much milk, butter, or carbohydrates are ingested, fatty acids may be formed in small amounts in the normal stomach, and it is not uncommon in patients convalescing from febrile disease who are partaking heavily of these foods in fluid form to present small amounts of fatty acids in stomach contents, which acids disappear when the recovery is more advanced and a mixed diet has been resumed. In amounts difficult to ascertain, the fatty acids (the same as lactic acid) may be present in contents from normal stomachs, but when plainly evident, some pathological condition of the stomach is usually present. Among the conditions in which this is so, are states of excessive gastric juice secretion, atony, chronic gastritis, and in benign stenoses of the pylorus where HCl secretion is present. In cancer, fatty acids may exist with lactic acid, the latter, as Flügge has shown, probably being derived from butyric acid as well as being a direct product of the fermentation. In early cancer, the fatty acids may be present to a greater extent than lactic acid. Acetic acid fermentation is common in alcohol drinkers, but may be formed by the action of yeast upon sugar. Excepting in alcoholics, butyric acid fermentation is more common than acetic. The presence of the volatile fatty acids in increased amounts can easily be tested for by gently heating about

10 cubic centimeters of gastric filtrate in a test tube over the top of which is placed a strip of blue litmus paper which turns red while on the tube, and in a short time returns to a blue color again when the filtrate becomes cold or if the paper is taken away. A quantitative estimation of the amount of fatty acids can be determined by obtaining the acidity of 10 cubic centimeters of gastric filtrate. Another 10 cubic centimeters are evaporated to a syrup (during which the fatty acids solatilize), water is then added to a 10-cubic-centimeter total, and similarly titrated. The difference in acidity between the two represents the amount of fatty acids present.

**Butyric Acid Tests.**—Butyric acid, in even slight amounts, can usually be recognized by its odor alone, which is that of rancid butter. When acetic acid is mixed with it, this odor is somewhat masked and the following tests may be utilized:—

Ten cubic centimeters of gastric filtrate are extracted with 50 cubic centimeters of ether. This is evaporated and the residue treated with about 2 cubic centimeters of water. If a few crystals of calcium chloride are added, a separation of butyric acid takes place in the form of small fat globules, which have the characteristic odor of the acid; or the dry residue of the ethereal extract may be treated with a little sulphuric acid and alcohol which causes ethyl butyrate to form, and this can easily be recognized by its distinct pineapple odor.

**Acetic Acid Tests.**—Acetic acid is recognized by its pungent odor, which is that of vinegar. Ten cubic centimeters of gastric filtrate are extracted with ether, the residue dissolved in a little water, and neutralized with a solution of sodium carbonate (sodium acetate being formed). To this is now added a drop or two of very dilute ferric chloride solution, when a deep-red color results. Furthermore, silver nitrate produces a precipitate which is soluble in hot water. Another test is to add to the evaporated ethereal extract dissolved in a little water and neutralized with a solution of sodium carbonate, a few drops of sulphuric acid and alcohol, after which the characteristic odor can be observed on heating.

#### BLOOD IN GASTRIC CONTENTS.

The presence of blood in gastric contents is recognized without difficulty by its bright-red color when fresh, and its dark-brown or blackish color when altered by the gastric juice. There are filtrates in which the blood is too small in amount to be recognized by the eye, or changed to such an extent that on macroscopic examination doubt exists as to its presence, and lastly, there is the important form in

which blood may be present and no color is imparted—namely, the so-called "occult blood." In these latter instances, chemical tests for the presence of blood are important, because of the doubts (above mentioned) in the macroscopic examination, the fact that it is unsatisfactory to microscopically search for blood corpuscles in the amylum of test-meals, and the fact that the red corpuscles may have been dissolved and thus not be recognizable.

Blood in the stomach contents is found particularly in gastric cancer and ulcer. It may occasionally be present in benign stenoses of the pylorus, and less often in chronic gastritis (from the "catarrhal ulcers"). It may be present in small amounts in acute gastritis (particularly the toxic types), and rarely in phlegmonous gastritis. It is not uncommonly found in gastric sarcoma of a primary nature, but not in multiple sarcomata in which the stomach walls are secondarily involved. I have observed it in small amounts in a few cases of primary gastric atony, and once in injury to the epigastrium. Among the other conditions in which it may be present in the stomach, is in traumatism from the expression method of extracting test-meals; when swallowed from the nose, lungs, or esophagus; from rupture of an aneurism into the gullet or stomach; in the passive congestions due to heart or lung disease, or obstructive states of the portal circulation; in the severe anemias, hemophilia, scurvy, purpura hemorrhagica, and vicarious menstruation; in Hodgkin's disease, and in the infectious diseases—such as typhus, yellow, malarial or relapsing fevers, malignant small-pox, hemorrhagic scarlet fever, etc.

**General Extraction of the Hemoglobin Present.**—Before beginning a consideration of the various chemical tests for blood in gastric filtrates (as well as in feces), it is important that the blood constituent be extracted. For this purpose a method of extraction which will serve for all of the various chemical tests is desirable instead of the different methods given in the routine of the various tests as they were originally advanced. A method I have found satisfactory for gastric filtrate and feces is the following: As much of the gastric filtrate as is on hand, or about one-half a test-tubeful of a watery solution of feces, is treated with one-third its volume of glacial acetic acid, and one-half its volume of ether. The mixture is thoroughly shaken and allowed to stand for fifteen minutes, or until separation is complete. Should this be tardy the addition of a few drops of ethyl alcohol will hasten it and a short centrifuging also helps materially in the separation. When the ether has separated, dissolved in it will be the hemoglobin from the blood present, and this is tested for in the below-mentioned ways. In my opinion, it is advisable not to depend upon any one

hemical test for blood, but to perform two or three of them with each acetic ethereal extract.

**Guaiac Test.**—This test is delicate enough for practical purposes but not as satisfactory for routine work as the benzidine or the aloin tests. The test is accomplished by the oxidation of guaiacconic acid in the presence of blood into a guaiac blue, the color of which is easily recognized. The testing solution of guaiac is made in several ways but the following one is advised: A fresh alcoholic solution of guaiac is made by scraping (with a knife) a few grains of old gum guaiac into about 1 cubic centimeter of alcohol. (The area of the guaiac which has yellow particles in it makes the most sensitive solution for the reagent.) To the alcoholic-guaiac solution is added about 2 cubic centimeters of hydrogen peroxide and the contents are shaken. To this mixture is added about 1 cubic centimeter of the acetic-ethereal extract and in the presence of blood a blue-violet color will appear in the upper part of the mixture (Plate LI, Fig. 1). In the examination of feces containing blood, a purplish-brown color may be noted due to the blood and the urobilin contained in the extract. If no blood be present no color at all, or only a faint brown from the urobilin, would occur.

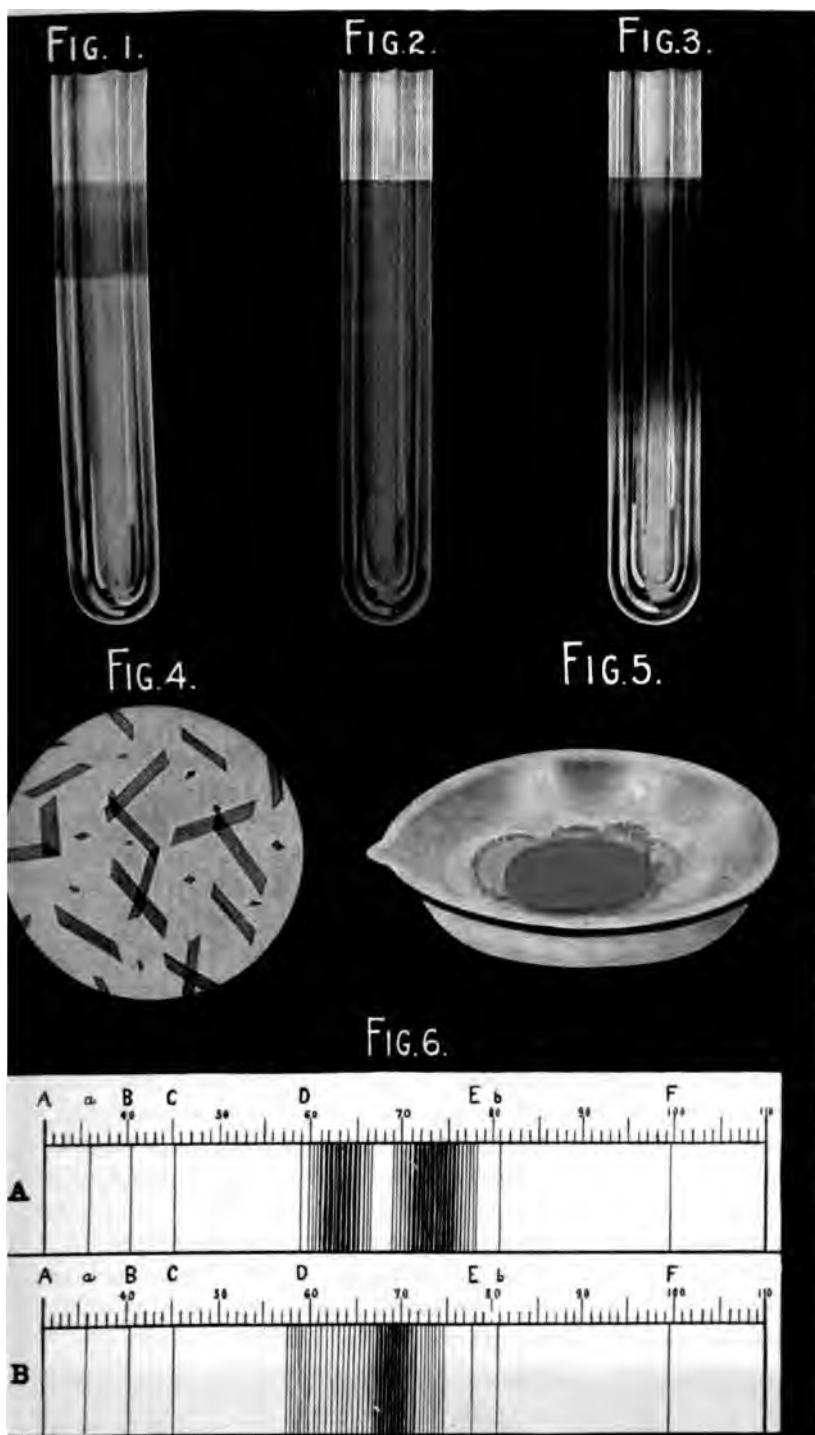
**Aloin Test.**—This test is a very valuable one for blood in feces and, with the following, has my preference over the above. The reagent is prepared as follows: In a test tube about one-third filled with a 70-percent alcohol, a small amount of powdered aloin is added (about as much as can be held on the tip of a spatula) and a few minutes are allowed for it to dissolve. About 3 cubic centimeters of the acetic-ethereal extract is placed into a tube, to which an equal amount of the aloin solution is added. The mixture is treated with 1 or 2 cubic centimeters of thoroughly ozonized turpentine (prepared by allowing chemically pure turpentine to stand exposed to the air for about a month), or an equal amount of hydrogen peroxide (the turpentine is best). The mixture is thoroughly shaken and if blood is present the reaction appears in the lower part or all of the solution, turning it a cherry red in a short time. If the ozonized turpentine is added drop by drop only the lower part shows the depth of color (Plate LI, Fig. 2). The reaction is not as quick as that of the guaiac or benzidine tests, and some minutes may be necessary for it to become pronounced. But in this connection it must be remembered that not more than 15 minutes should be allowed for this to manifest itself, because beyond this time the mixture will develop a red color even if no blood be present.

**Benzidine Test.**—This test has recently been advanced by O. and R. Adler,<sup>16</sup> and is strikingly sensitive to blood. Unfortunately such substances as potato, milk, and farina may cause the reaction and

therefore it is not so applicable for feces examinations, but in test-meal work it is sufficient to remember that nothing in the white bread and water of the Ewald meal can produce it, and thus when the filtrate of a simple meal from a non-stagnant stomach gives the reaction, blood is invariably present. The reagent is prepared by dissolving about as much benzidine crystals (Merck) as can be held on the end of a spatula in one-third of a test tube of 70 per cent. alcohol. When the crystals are dissolved, an excess of hydrogen peroxide is added (about one-fourth of the amount), and to the top of this the acetic-ethereal extract is added. When blood is present an intense green color forms (Plate LI, Fig. 3), and when absent, only a milky white. A paper soaked with benzidine solution and dried has recently been advanced by Einhorn<sup>17</sup> which, in my experience, is not as sensitive as the above method, and rather difficult to handle properly. Inasmuch as the original benzidine is far too delicate for clinical work, Schlesinger and Holtz have modified it by using a small amount (2 to 3 drops) of the material for examination, and excluding oxidizing ferment as a source of error by boiling. The technique is as follows: the material for examination consists of simple gastric contents; or of a pea-sized piece of feces thoroughly stirred in a test tube containing about 4 cubic centimeters of water. This is brought to a boil to destroy the oxidizing ferment. Ten drops of a fresh solution of benzidine (prepared by shaking a knife-tipful of benzidine in about 2 cubic centimeters of glacial acetic acid) is added to 3 cubic centimeters of a 3 per cent. (ordinary commercial) solution of hydrogen peroxide in a test tube. This mixture serves as a control for the cleanliness of reagents and glassware. To make the test, add 2 or 3 drops of the boiled gastric contents or of the feces mixture to the peroxide benzidine mixture. A clear green or blue color appears within a minute or two when blood is present. It is desirable to add the drops of material to be examined without shaking the mixture, in which case a deep ring of color develops only on top, serving to give a sharper result when the blood is small in quantity.

**Boas' Reagent.**—Recently (1911) Boas recommended a test which he places in delicacy midway between the guaiac and benzidine. The reagent is made by dissolving 1 or 2 grams of phenolphthalein and 25 grams of potassium hydroxide in 100 cubic centimeters of water and heating gently until decolorized in the presence of 10 grams of powdered zinc, the solution being permanent. The test is made by adding 2 cubic centimeters of gastric content or feces and water, previously boiled and cooled, to 1 cubic centimeter of the reagent and a few drops of hydrogen peroxide. A prompt red or pink color is positive. The sources of error in general are the same as for the benzidine test and similarly excluded.

PLATE LI.



Tests for Blood.—Fig. 1, Guaiac. Fig. 2, Aloin. Fig. 3, Benzidine. Fig. 4, hemin crystals. Fig. 5, Iron test. Fig. 6, Spectroscope. A, Oxyhemoglobin. B, deduced hemoglobin.



diet and boiling. Heat alone will give a positive test and must be avoided. Boas advises making an ether extract of the material to be examined instead of boiling it to exclude sources of error, such as the lizing ferment. This, when an original acetic acid-ether extract is used throughout different tests, is handiest.

Although the early reports of French authors claimed that this test was extremely delicate, much more so than the original benzidine test, giving a positive reaction with 1 part of blood in 1 or 2 millions in watery solutions, and being thus said to show the presence of even congestion of the mucous membrane, my experience has been that it is less delicate than the benzidine test, and more so than the guaiac, if approximately the same technique is used for all. The phenolphthalein test is a little more delicate for blood in watery solutions and in gastric contents, and almost exactly the same for blood and feces. The point is, that a test for blood must not be too delicate or liable to give negative results when amounts of blood of clinical importance are present. Therefore, the order in which I consider them is about as follows: Schlesinger and Holtz benzidine, Boas' reagent, aloin, and finally the guaiac.

**Hemin Crystals.**—Hematin readily combines with one molecule of hydrochloric acid to form hemin. This substance crystallizes in thin plates or columns, and, when produced by means of glacial acetic acid, are large in size with small star or rosette crystals in addition. Hemin may be formed from mere traces of blood, and when produced from gastric filtrates is conclusive evidence of the presence of blood. Negative results from the test should not be considered as conclusive of the absence of blood, because substances in the filtrate may interfere with the formation of these crystals even when blood is quite plainly present to the naked eye. To observe the crystals, a small sample of gastric filtrate is carefully evaporated on a watch crystal over a small flame, and the residue is scratched free and mixed with a grain or two of finely powdered salt (sodium chloride). This is transferred to a microscope slide, heaped in a small area, and a drop or two of glacial acetic acid added. The slide is now gently heated for a minute, or until bubbles begin to form, allowed to cool, and examined under the microscope with a one-sixth or a one-seventh objective. The hemin crystals (hydrochlorate of hematin) are readily observed by examining the little brown clumps (Plate LI, Fig. 4).

**Iron Test.**—Providing the patient is not taking an iron preparation this test is used. It is simply performed and very sensitive to even the most trivial amounts of blood. It is carried out by placing a small amount of the unfiltered gastric contents in a porcelain dish, mixing it with a pinch or two of potassium chlorate and a few drops

of concentrated hydrochloric acid, mixing these thoroughly and heating the contents over a small flame to drive off the water and chlorine and obtain a perfectly dry residue. A few drops of a diluted solution of potassium ferrocyanide are added when, if blood is present, the color of Prussian blue develops (Plate LI, Fig. 5).

**Spectroscope.**—When blood is present in the fresh state the gastric filtrate may be examined directly by the spectroscope and the absorption bands of oxyhemoglobin between D and E observed in the spectrum. The one to the left is narrower, darker, and more sharply defined than the other (Plate LI, Fig. 6, A). Because blood in gastric contents is commonly more or less reduced by the hydrochloric acid or the organic acids in the stomach, and hydrochlorate of hematin is produced, this, being insoluble in water, may not give absorption bands; and because chlorophyll (the green coloring matter in vegetables) gives absorption lines similar to a solution of hematin, Weil has advised treating the gastric filtrate or aqueous feces mixture with an alcoholic solution of potassium lye and extracting the blood pigment from an ethereal extract in a watery alkaline solution which is treated with ammonium sulphate. The resulting liquid, red in color, will then give the absorption bands of reduced hemoglobin, namely, lines in the green. Reduction of the oxyhemoglobin can be performed directly by means of "Stokes fluid," or ammonium sulphide (Plate LI, Fig. 6, B). Spectroscopic observations, the hemin or iron test, are not preferable for gastric filtrate or feces examinations to the simple and more delicate chemical tests.

Boas<sup>18</sup> says that Snapper's spectroscopic method for determining occult blood in the stomach content and feces is not so sensitive as some other methods, so that only positive findings are reliable until the technique is further improved. But he reiterates that the occult blood findings with a reliable method permit the diagnosis and differential diagnosis of cancer with a certainty not to be attained otherwise, as his thirty years of experience have demonstrated. The spectroscopic method gives identical findings with those of Gregersen's modification of the benzidine technique. Even 2 cubic centimeters of blood introduced into the stomach gives the hemochromogen stripe in the spectroscope, which renders it possible to test in this way the reliability of any and every cancer test. The simplicity and reliability of the Gregersen technique commends it to the general practitioner as decided progress in the diagnosis of cancer, but the chloral-alcohol-guaiaac test is the most sensitive of all. Vegetable oxidases can be destroyed by boiling or with mineral acids which do not affect hematin. In 282 cases of gastric cancer confirmed by operation, in four German clinics, occult blood was found in from

to 95.2 per cent. of the cases. Taken in connection with the clinical findings, it may prove decisive, although there is no absolutely pathognomonic sign of gastric cancer or ulcer. For the Gregersen technique, 0.02 gram of benzidin is dissolved in 5 cubic centimeters of 50 per cent. acetic acid. To this, he adds 0.1 gram of barium peroxide for the catalyzer. The test is then applied as usual. The reaction is invariably negative in normal persons on a milk-vegetable diet. Boas has both of the reagents for the Gregersen test made up in tablet form, and applies the test on a porcelain dish or visiting card, instead of the slide used by Gregersen.

#### BILE AND ENTERIC SECRETIONS IN GASTRIC CONTENTS.

Bile in the stomach is present in stenosis of the intestines, late in excessive vomiting in migraine, atony, prolapse, vomiting from dietary error, or even in the healthy stomach. With the exception of the morning stomach, it is usually present with the enteric secretions, and tests for these will here be included.

A tryptic enzyme is almost constantly present in the fasting and digesting contents of the normal human stomach. The tryptic enzyme is deduced to be trypsin regurgitated from the duodenum. Trypsin in the gastric contents is highly resistant to the action of acid and pepsin. In general, the tryptic value is high in the presence of low acidity and in alkaline reaction, and of low value when the gastric contents are of high acid concentration. A fall in the acidity is usually accompanied by a rise in the tryptic values. The color of the gastric contents often changes during the period of experiment from that of the ingested material to a golden yellow or a dark olive or blue green. This color change is due to regurgitation of bile from the duodenum and is absent on a diet of substances which do not cause the outpouring of bile. The tryptic values in the gastric contents usually rise concomitantly with the color change, although in a non-bile stimulating diet the tryptic value seems independent of the color. Sodium bicarbonate in 5 per cent. solution is held in the stomach until sufficient hydrochloric acid is secreted to bring the alkalinity to a point in which it is non-irritating to the duodenum. The retention is accompanied by a high trypsin value, suggesting antiperistalsis in the duodenum in response to an irritant. Sodium bicarbonate in 1 per cent. solution hastens the emptying of the stomach either by increasing the motility of the stomach or opening the pylorus. Sodium bicarbonate solutions do not inhibit human gastric secretion, but seem to have a direct stimulatory effect in some cases. Free hydrochloric acid seems unnecessary for the opening of the pylorus, for the stomach sometimes empties

while its contents are still alkaline. Ingestion of 0.5 per cent. hydrochloric acid is followed by a rapid fall in acidity to about 0.2 per cent., due to a regurgitation of alkaline duodenal contents, as is indicated by the rise in trypic values coincident with the fall of the acidity. The acid is then emptied from the stomach. Regurgitation of duodenal contents into the stomach is but another of the protective functions of which the body furnishes so many examples and has for its purpose the defense of the small intestines from irritants.

**Tests for Enteric Secretions.**—The presence of bile can readily be recognized by the yellow color it imparts to the gastric contents or lavage water, and as the most trivial amounts are discernible to the naked eye further tests for it are not necessary.

The presence of succus entericus can only be assumed when bile and pancreatic juice are both present. Tests for this particular secretion have not been advanced as yet and it seems to me would not serve of much practical importance if they had been.

The demonstration of pancreatic juice is possible only if the reaction is alkaline, as the pancreatic trypsin is destroyed or inhibited by the pepsin-hydrochloric contents of the stomach. Tests for the presence of the pancreatic enzymes are performed by first rendering the gastric filtrate alkaline by the addition of a 1-per-cent. solution of sodium carbonate, and then the separate enzymes are tested for in the following manner:—

**Trypsin.**—The addition of the alkaline solution inhibits the action of the pepsin and makes possible that of the trypsin. A small amount of the gastric filtrate is placed in a test tube to which is added a flake of fibrin, or a few flakes of fibrin previously colored by immersion in a little Megdala-red solution, after which they are washed and dried. The test tube is placed in a thermostated oven, in which, after a time, the fibrin dissolves, and produces tyrosin and leucin. With the employment of the red fibrin flakes as digestion takes place, the red is liberated, coloring the filtrate.

**Amylopsin.**—This diastatic ferment acts quite the same as the ptyalin of the saliva (which is also an alkaline secretion), and because more or less saliva is generally present in all stomachs, tests for this ferment are not of so much practical value as those for trypsin and the fat splitting ferment (lipase). The test for the diastatic ferment consists of mixing 1 or 2 cubic centimeters of the alkaline gastric filtrate with about four times that amount of dilute starch paste, placing this in the water-oven for a short time or in a glass of warm water, and then testing for maltose by means of the Fehling test.

*Steapsin*.—The test for this is simply accomplished by placing a few drops of the alkaline gastric filtrate on a watch crystal, to which a like amount of neutral olive oil is added with one or two drops of alcoholic rosolic acid, at which the mixture takes on a pink color. The mixture is now covered hermetically with a second watch crystal, placed in a water-oven for about an hour and, when lipase is present, the pink color gradually disappears.

To measure the lipase, Hanriot and Camus have suggested a method wherein a solution of monobutyryl is employed. They take one cubic centimeter of the liquid to be tested and add to it 10 cubic centimeters of a 1-per-cent. solution of monobutyryl. The solution is carefully neutralized with sodium carbonate and then heated to 25° C. for twenty minutes. Under the influence of lipase, the liquid becomes acid, and this acidity is estimated by again neutralizing the solution with sodium carbonate; the number of drops serves to measure the fat-splitting activity. The solution of sodium carbonate used for the saturation is prepared in such a way that each drop of the alkaline liquid neutralizes 0.000001 of a gram-molecule of acid. The ferment power is expressed by the number of millionths of a gram-molecule of acid freed during twenty minutes at 25° C. The molecular weight of butyric acid being 88, the computation is easily made.

#### GASES IN THE STOMACH.

A greater or less quantity of mixed gases, which have been swallowed, passed into the organ from the duodenum, or generated in the fermentation process when carbohydrates or fats have been ingested, is found in normal stomachs. The gases commonly found are nitrogen, carbon dioxide, and oxygen, and, according to Planer, with a strictly vegetable diet, hydrogen in addition. It therefore follows that a certain quantity of these gases must be considered as a normal gastric content, and it is only when their volume per cent. is too high, or when other gases, as marsh gas, hydrogen sulphide, and ammonia, are added that they are of pathological significance.

In marked degrees of gastric stagnation, when carbohydrate fermentation and proteid decomposition are marked, the general gaseous content may be high. Strangely enough in gastric ulcer, when gastric juice secretion, hypermotility, and a patent pylorus are present, increased fermentation of gastric contents is not uncommonly seen, and this, in my opinion, is due to the increased amounts of bacteria found in the stomach during ulceration and constitutes a valuable diagnostic sign when other findings are not significant. It has been

reported that in gastric neuroses slightly increased degrees of fermentation of gastric contents may be noted, particularly in those types in which the hydrochloric acid content runs high. To this I wish to take exception, because after estimating the amount of gas resulting from the fermentation of neutralized test-meals in these cases I found that such was not the case and only the merest bubble is ever seen in any of them. While such cases may have been diagnosed as neurotic conditions in the past, the majority, if not all, are cases of gastritis with increased amounts of volatile organic acids or cases of ulceration with increased bacteria in the stomach. In ulcer the gases commonly observed are those normally present, and not the putrefactive forms from albuminoid decomposition, such as ammonia and hydrogen sulphide. In nervous eructation, where the belching of gas is usually that swallowed from the esophagus, increased fermentation of gastric contents is not seen, and thus a low gas content would serve to differentiate whether the symptom of post-meal eructation was due to the foods themselves, or just a neurotic disturbance of the stomach.

Clinically, in stagnant conditions of the stomach, not so much diagnostic value can be placed upon the gaseous products of albuminoid putrefaction (marsh gas, ammonia, hydrogen sulphide), as upon those more definitely due to carbohydrate fermentation—namely, lactic, butyric, or acetic acids, the latter two of which are volatile. For it is strange that hydrogen sulphide, for instance, is an uncommon finding in late cancer of the stomach, whereas in atonic conditions of a benign nature (whether primary or secondary to obstruction of the pylorus) it is by no means so rare. While this is not advanced as a rule for the differential diagnosis between cancer and the benign conditions, nevertheless, when the fermentation organic acids are absent or low in amounts, and those from albuminoid decomposition high, it is somewhat of an argument against cancer being the cause of the stagnant condition of the organ. On the other hand, when the organic acids are high, even if the putrefactive gases are also a marked feature, one would be led to view that content as most probably from a case of malignant disease. To briefly state my observations in this matter, I would say, that where fermentation of gastric contents is increased, and the gases found are those normally present in healthy stomachs, ulceration or irritative conditions of the organ, from any cause, are suggested; that when the organic acids are high with or without the putrefactive gases, cancer is probably present; that when only butyric or acetic acid is present in distinct amounts, and lactic acid decidedly less so or absent, or when just the putrefactive gases are the main feature of the stomach contents, that only atony or bacterial increase

can be diagnosed; and lastly, that when the intestinal secretions are constantly present in the stomach and the putrefactive gases a feature, intestinal stenosis from some cause is suggested.

**Test for Gases.**—To obtain a knowledge of the gases formed in the stomach during the process of digestion the gas-collecting apparatus of Hoppe-Seyler<sup>10</sup> may be used for direct extraction, or any form of gas-collecting fermentation-tube may be employed with the gastric contents. Among the latter forms of apparatus that are readily procurable are the Doremus ureometer and the Einhorn saccharometer—the first is preferred because of its larger size. The drawback to the use of these closed end tubes is, that, with the exception of only a carbon dioxide content in the chamber, it is quite difficult to extract the gases for estimating the presence of the volatile acids, hydrogen sulphide, or marsh gas. For this reason, I have constructed a simple apparatus which is of larger caliber and shorter than the ureometer, and is not so complicated or impractical for clinical use as the laboratory forms of apparatus used in gas analysis. It also answers for the gas results obtained in the chemical and bacteriological examinations of feces, and will be found described elsewhere. The unfiltered gastric contents are used (which are first neutralized when HCl is present by a normal solution of sodium hydrate), and the apparatus is placed in the water-oven at 37° C. for twenty-four hours, at which time the observation is made.

After many hundred examinations of test-meals from stomachs in which a normal or excessive HCl secretion existed, it is surprising how uniformly low the gas results were found to be. In these instances one never meets with more than a few small bubbles of gas, and I believe that 2 per cent. of gases may be taken as an extreme limit. In the acid form of chronic gastritis this may be somewhat higher, reaching in several instances to 4 and 6 per cent. In sixty-nine cases in which I believed gastric ulceration to be present (thirty-seven of which proved to be so at operation, the rest not being operated upon) the gas content ranged from 4 to 11 per cent., with 7 per cent. as the average of them all. In all of these, a larger amount of HCl secretion than is normally seen was present; it may here be remarked that about one-half of the cases of ulcer have a normal and even an absent HCl secretion, and in these the positive high gas results may be more definite. In hypoacidity, when the volatile acids are a prominent feature of the gastric contents (chronic gastritis); in the low-grade infections; in the acute inflammatory conditions; and rarely in the irritative form of neuroses, the gas content was above 2 per cent., but generally not so high as in the ulcerated conditions. In my opinion,

- the larger the gas content with high HCl, the surer is the case apt to be one of ulcer. In the markedly stagnant states of the organ, the gas collection was the highest, usually over 10 per cent., and in one of my cases of pyloric cancer it was found to be 56 per cent.

### ACETONE IN GASTRIC CONTENTS.

As a product of the decomposition of albuminoid bodies the acetones are found in gastric contents. Following v. Jaksch and Lorenz,<sup>20</sup> I have repeatedly demonstrated acetone in the distillate of gastric contents, the quantity occasionally exceeding that found in the urine. In the presence of acetonuric conditions, like diabetes mellitus, the infectious fevers, or pregnancy, the acetones may be found in the stomach as an excretion into that organ from the circulation, just the same (but not to the extent) that it is found in the urine; therefore, in these conditions, the presence of acetone in the stomach would not be so significant as in the primary diseases of the organ in which such may be found. Acetone in gastric contents is strongly suggestive of gastric dilatation, and as this condition is commonly observed in its highest degrees in cancer it possesses a diagnostic significance in that connection. On the other hand, an acetone content may be met with in simple atony and in the secondary forms following pyloric stenoses of a benign nature. I have occasionally observed it in marked states of stomach prolapse (probably because of the accompanying atony or for dynamic reasons due to change of form), but never in the clean-cut gastric neuroses.

There are several tests for acetone that can be used for gastric filtrates or urines. The methods in which previous distillation are advisable (Lieben's, Gunning's) make them rather difficult for clinical work, and, because albuminoids are generally present in gastric contents and often in urine they rather complicate the Dunninges test. The color tests of Frommer and of Legal answer sufficiently for practical purposes, and only these will be described.

**Frommer's Test.**—Ten cubic centimeters of gastric filtrate (or urine) are treated with 1 gram of caustic soda, and immediately there is added about 1 cubic centimeter of an alcoholic solution of salicylic aldehyde (1 to 10 of absolute alcohol). The mixture is quickly heated to just short of the boiling point when, if acetone is present, a purple red color results at the zone of contact with the alkali. If a caustic soda solution is used, the fluid first becomes a yellow and then goes through the colors of red and purple to a deep carmine. This course of colors is best noted when the fluid is heated. For laboratory work the solution of the alkali is handiest.

**Legal's Test.**—This test is not as reliable as the above. It consists of adding to about 5 or 10 cubic centimeters of gastric filtrate (or urine) a few drops of a weak solution of sodium nitroprusside and a strong solution of sodium hydrate, at which the mixture assumes a red color, which rapidly disappears, and in the presence of acetone is replaced by a purple or violet red when acetic acid is added.

#### NITROGEN IN GASTRIC CONTENTS.

The performance of the so-called Solomon test is of value in the early diagnosis of gastric cancer; but too much importance must not be placed upon negative results, for even in late cancer they may be present. The presence of nitrogen (or albumin) in the stomach at these times is due to the transudation of blood-serum or blood into the empty stomach. To test for it the stomach is washed out in the evening, and on the following morning 400 cubic centimeters of normal salt solution are introduced into the organ and extracted after a short stay. The presence of more than 30 milligrams of nitrogen, or a marked turbidity with the Esbach reagent (picric acid), is suggestive of cancer. Because of the simplicity of the Esbach method of testing the saline solution, and the complicity of the Kjeldahl method for quantitatively estimating nitrogen, the performance of the former is advised in routine clinical work. The Kjeldahl method is found described elsewhere, and answers for estimating nitrogen in gastric contents, urine, and feces.

The statement that the gastric juice may contain ammonium salts is by no means of recent origin. It can be found in the classic monograph on the digestive secretions published by Bidder and Schmidt<sup>21</sup> in 1852. Subsequent observers have as a rule admitted the occurrence of ammonia in the secretion of the stomach, though most of them have not found it present invariably or under uniform conditions. The theories as to its origin are manifold; they include suggestions of the production of the ammonia by enzymatic deamination reactions taking place in the gastric mucosa, and likewise of the origin of this nitrogenous compound in the reactions leading to the elaboration of the acid gastric juice. As ammonia is a usual component of the urine, it may be looked on, therefore, as a form of excretory nitrogenous matter; and since it has become unquestioned that the gastro-intestinal tract may serve, like the kidneys, as a channel for the excretion of certain types of compounds, it is not far-fetched to inquire whether or not the ammonia of the gastric juice may accordingly represent an attempt at an excretion of ammonia by way of the alimentary canal. The dependable facts in regard to the subject have

been elaborated by the recent studies of Huber<sup>22</sup> at the Hull Physiological Laboratory of the University of Chicago. According to these ammonia is normally found in small amounts in the gastric juice of man and dog. The amount of ammonia in the pure gastric juice of man varies markedly in different individuals. It is increased by high protein diet, and by the addition of ammonium salts to the food. The fundal mucosa contains the most ammonia, the pyloric mucosa is next in order, while the mucosa of the cardiac end of the stomach contains the least ammonia. The duodenal mucosa contains less ammonia than the fundal mucosa. In certain pathologic conditions (especially gastric ulcer and cancer) the amount of ammonia in the gastric juice is definitely increased, but this increase may not be greater than that found persistently in certain normal individuals. These observations seem to indicate that the origin of the ammonia of the gastric juice is a complex one. This may be the case. When the concentration of ammonia in the blood is high it is evidently secreted to some extent through the stomach wall. However, the report of the isolation of a fairly constant bacterial flora from the pure gastric juice of man inevitably suggests the conclusion that enzymatic or bacterial action on the stomach mucosa or on the gastric juice may be responsible for some of the ammonia found in the gastric juice in some cases, even though the constancy of the ammonia content of the fresh juice of normal man and dog speaks against this as the sole or principal origin. In the human in ulcerative conditions the ammonia content is increased.

#### EXAMINATION OF THE FERMENTS OF THE GASTRIC JUICE AND THEIR ZYMOGENS.

The gastric juice as represented by the enzymatic content is a more reliable and important indicator of the functional power of the glandularis than is the hydrochloric acid. From my separate analyses of the enzymatic and acid contents of many test-meals, it can definitely be stated that most often both of these secretions are increased or lowered to a fairly equal extent; but that this is a rule that cannot be depended upon (excepting possibly in atrophic conditions of the glandulature) when employing only the quantitative acid analyses for estimating stomach secreting power there is no doubt. In the irritable conditions of the stomach both secretions are usually high; but when from emotional or psychic reasons the acid secretion is high, the enzymatic content may be normal or low; or again, the acid may be low and the pro-enzymes be present in normal amounts. In gastritis acidica, the hydrochloric acid may be high and the enzymatic content low. It is also well known that in anomalies of menstruation, in con-

gestive conditions, and in acute and early chronic gastritis, the hydrochloric acid secretion may be low or absent and the secretion of gastric pro-enzymes normal or but slightly changed. It must thus be plain that in diagnostic, therapeutic, and prognostic ways, the more specific secretion of the gastric juice (the pro-enzyme) is a more important indicator of organic change in the secreting apparatus of the stomach than is the acid, and for this reason the performance of quantitative as well as qualitative tests is essential. As the qualitative tests are comprised in the quantitative estimation only the latter will be considered.

**Pepsin and Pepsinogen.**—According to the many observations that have already been made, the ferments of the stomach are secreted as pro-enzymes, and pepsinogen, or propepsin, is transformed into the active pepsin by the free hydrochloric acid of the gastric juice. The activity of this ferment is destroyed or inhibited by the addition of the alkaline carbonates, and, when the pepsin is in solution, by a temperature of 70° C. It is to-day conclusively settled that free hydrochloric acid is the acid *par excellence* for rendering this pro-enzyme active, and that while other acids (sulphuric, lactic, acetic, etc.) can activate propepsin, much larger quantities of them than of the hydrochloric acid are necessary, and that the activation thus produced is not so prompt or perfect.

Under normal conditions, 25 cubic centimeters of gastric juice will dissolve 0.05 gram of serum albumin in one hour, the same amount of coagulated egg albumin in three hours, and a like amount of fibrin in one hour and a half. Since the reduction of the albuminoids to absorbable peptones is pepsin's specific action, and since this is accomplished in a definite time for each of the above-mentioned substances and amounts, a standard has been formed for noting the enzymatic power of gastric filtrate. It must be plain, however, that pepsin withdrawn from the stomach and tested without it is a far different substance from pepsin active within the stomach during the complex process of digestion in the organ, and thus laboratory estimations (when free HCl is sufficient to activate all of the pro-pepsin present) should always be considered as somewhat lower than the actual conversion power present in the stomach from which it was drawn. But when the HCl secretion is low, the addition of an acid to the filtrate may activate more pepsin without than actually occurs within the body. For these reasons, we must be satisfied with approximate estimations, which, when carefully performed, are accurate enough for clinical purposes. It must be remembered that indifference in measuring and weighing the quantity of Ewald meal ingested—particularly the water—and in noting the time

of its removal could cause much variation in the quantitative estimations of the enzymes. Also, that tubes used for the extraction of these test-meals should not contain any excess of water or lubricating fluid, and that the vessels used in the examinations should be dry.

**Mett's Method.**—Satisfactory comparative results can be obtained by the use of the Mett method, which, by careful technique, is surprisingly accurate even in the face of the complex character of inhibitory factors usually present. As a quantitative and qualitative method it is much superior to the use of the customary albumin disks, first, because the tubes are easy to prepare and keep for a long time, and secondly, because of the more definite and easily obtainable results.

For the purpose, several tubes about a foot long, 1 to 1.5 millimeters in caliber, and with thick walls, are secured, and the whites of several eggs are thoroughly mixed so as to obtain a homogeneous fluid. By mouth suction, the tubes are filled with egg albumin, care being taken that no air bubbles are contained, and the ends plugged with little balls of moistened bread. When the tubes are filled, they are dropped into a long, flat pan containing an inch or so of warm water, which is rapidly brought to a boil, this being continued for five minutes to obtain complete coagulation. After drying, the tubes are hermetically sealed with sealing wax or paraffin, and laid away for several days, or until the first seen fine bubbles disappear. When needed for use, these tube lengths are cut into sections 3 centimeters or 4 centimeters in length (by means of a triangular file and broken), and only such sections are used as have an even end of both albumin and tube, and that do not show the presence of bubbles.

For the routine of estimations we employ the undiluted gastric filtrate (15 cubic centimeters or less), a dilution of one-fourth (4 cubic centimeters to 12 cubic centimeters), and a dilution of one-sixteenth (1 cubic centimeter of filtrate to 15 cubic centimeters of one-twentieth normal HCl solution); the last dilution is used for quantitative estimation. Each one of these is placed in a covered dish of the Stender type with two Mett tubes, and the specimens allowed to digest in the water-oven (at 37° C.) for twenty-four hours. At the end of this period, the tubes are taken out of each dish, the four ends of albumin loss measured by means of a pair of calipers, and an average reading calculated for each specimen. The relative amount of pepsin is then obtained by squaring the result; this in terms of millimeters raised to the square and multiplied by 16 (the degree of last dilution) indicates the relative amount of pepsin. Should it be seen that but little albumin (0.5 millimeter) remains in the last tube, the gastric juice must be diluted thirty-two times. The unit of measure is the amount of

pepsin by which 1 millimeter of albumin is digested in twenty-four hours in an acidity of 0.18 per cent. of HCl. A magnifying lens and a vernier measuring 0.1 millimeter or a low-power microscope with a stage micrometer are very convenient. In measuring, one end of the tube is placed against one jaw of the calipers, and the other jaw is separated until its edge is just visible through the opalescent edge of the albumin. If the tube had broken obliquely the shortest side is taken, while if the albumin is uneven the highest point to which digestion has reached is measured.

**Hammerschlag's Method.**—This is more easily performed than the above, and answers well as a relative method for routine work. When, however, a diagnosis is somewhat in doubt, either one of the other two methods described is preferable.

Two Esbach tubes (albuminometers) are employed. Tube A is filled to the mark U with a mixture of 10 cubic centimeters of a 1-per-cent. solution of egg albumin in a 0.4-per-cent. of hydrochloric acid, and 5 cubic centimeters of gastric filtrate. (The 1-per-cent.-solution of egg albumin is made by diluting egg albumin with thirteen times as much water). The second tube B receives a mixture of the same solution without the gastric filtrate but with 5 cubic centimeters of water instead. Both tubes are put into the water-oven and kept there at a temperature of 37° C. for one hour, after which they are taken out and Esbach's picric acid reagent is added to each tube to the mark R. The tubes are corked, inverted three or four times to insure thorough mixing, and after standing for twenty-four hours the amount of precipitated albumin is read off in each. The difference indicates the amount of albumin which was digested, and this raised to the square gives the amount of pepsin present. The principle of the method is, that such albumin as the pepsin has converted into peptone is not coagulated by the picric acid.

**Jakoby-Solms Method.**—The recently advanced ricin test, according to Jakoby and Solms,<sup>23</sup> is performed as follows: 1.0 gram of ricin is dissolved in 100 cubic centimeters of a 5-per-cent. sodium chloride solution and filtered. Two cubic centimeters of this solution are placed in a small test tube, to which first 0.5 cubic centimeter of decinormal HCl solution and then 1 cubic centimeter of diluted gastric filtrate are added. A ricin deposit takes place, which, when the tube is placed in a water-oven for three hours at 37° C., is cleared by the ferment present. For the purpose of a standard for quantitative estimation, Solms designates that the amount of gastric juice which is just sufficient to entirely clear the 2 cubic centimeters of ricin solution (when the test is performed as above mentioned) is one pepsin unit,

and that normally stomach contents contain about 100 pepsin units to the cubic centimeter of gastric juice.

For the purpose of making a quantitative estimation the gastric filtrate may be diluted 10, 20, 40 and 100 times, and 1 cubic centimeter of each of these dilutions is placed with the above mentioned amounts of ricin, sodium chloride, and decinormal HCl solutions in small test tubes appropriately marked. At the end of three hours these tubes are taken from the water-oven, and the amount of ricin deposit noted according to the dilutions in each tube. Normally, the deposit has disappeared in the dilutions 10 and 20, and if a deposit is noted in these tubes the pepsin may be considered as diminished, and in excess when absent in dilution 40 or above. In states of low gastric juice secretion the use of the filtrate itself, or only a dilution of 2 or 5 times may be necessary for the estimations.

The technique as advanced by Jakoby and Solms is as follows: The filtrate of the Ewald meal being employed, the total acidity and the free hydrochloric acid are first determined and the dilutions made according to the degree of acidity. In hyperacidity, dilutions of 1 to 100 or 1 to 10,000; and in hypoacidity, from 1 to 10 to 1 to 100. The estimation is made by means of five test tubes, to each of which has been added 2 cubic centimeters of the filtered ricin solution, and 0.5 cubic centimeter of a decinormal HCl solution. To the first tube is added 1 cubic centimeter of boiled gastric filtrate (the peptic activity of the gastric juice is destroyed by boiling); to the second is added 0.9 cubic centimeter; to the third 0.8 cubic centimeter; to the fourth 0.5 cubic centimeter; and none to the fifth. The gastric juice whose peptic activity is to be tested is then diluted with distilled water in the proportion of 1 to 100, and added to the tubes as follows:—

To tube No. 1, none; to No. 2, 0.1 cubic centimeter; to No. 3, 0.2 cubic centimeter; to No. 4, 0.5 cubic centimeter; and to No. 5, 1 cubic centimeter. Each tube then contains 3.5 cubic centimeters of fluid. The tubes are corked, placed in a water-oven (at 37° C.) for three hours, and the sediment observations made. The denominator of the fraction of dilution divided by the number of cubic centimeters of diluted contents required to clear the solution expresses the peptic activity of the gastric juice that is being examined. Thus, if with the dilution of 1 to 100, 1 cubic centimeter clears the solution the peptic activity is expressed as being equivalent to 100; if 0.5 cubic centimeter of the gastric filtrate diluted to 1 to 100 is sufficient to clear it, the peptic activity is 200. Accepting the peptic activity of juice from normal stomachs as 100 units, Solms reports that in subacidity the peptic activity varied between 10 and 20 units; in hyperacidity from 100 to

1000; that hyperacidity was not always accompanied by correspondingly high enzymatic content; that in gastric ulcer the units were high; and in cancer of the stomach or gall-bladder and pernicious anæmia they were greatly reduced below 100.

This method answers well for quantitative estimations, but for accurate analysis is not to be preferred to the older Mett method, which in my hands is more uniformly accurate. The main reason for this is, the more pepsin present in each of the tubes the more rapid is the disappearance of the sediment of ricin, and with the high dilutions, or low (when but little enzyme is present), three hours is not time enough to note differences with the deposited ricin, and in slow digestion some inhibitory chemical change affecting the activity of the enzyme, and thus the results of the test, takes place. For instance, it is not uncommon to observe with filtrates from normal stomachs that the one-tenth dilution may show no deposit, and the variation between 20, 40, and 100 to be distinctly more than these dilutions should signify.

Einhorn<sup>24</sup> has advanced an apparatus for the performance of this test which does away with the necessity of the water-oven, consumes less time, and in which the test tubes used are graduated in millimeters to note the amount of deposit. The quantitative results from its use, however, are still more variable than those of the original method.

**Edestin Method.**—The best of all methods is that devised by Rose,<sup>25</sup> and further modified by Farrington, Lewis, Brown and Boulder.<sup>26</sup> Quoting liberally from their article, since it represents that which I employ, the following is offered:—

"On account of the complicated technique involved in the preparation of pea globulin and because of the difficulty of obtaining it commercially, it seemed desirable to bring this admirable method of Rose, as modified by Givens,<sup>27</sup> into the hands of the practitioner by using a protein which could be readily secured. No attempt was made to obtain a chemically pure protein. Our object was rather to get a product of fairly constant composition by as simple a technique as possible.

"As shown in preliminary experiments, edestin has all the qualities needed in a substitute for the pea globulin of the Rose method. It is precipitated from sodium chloride solution by the addition of acid, is readily digestible at 50° C., and may be kept in dilute solution without deterioration for several months. Like pea globulin, edestin is non-poisonous, thus removing one of the objections to the Jacoby-Solms<sup>28</sup> ricin method. Coupled with these essential properties we have found that edestin may be obtained by a relatively simple procedure. The following method of preparation has proved most practical in our hands.

and that normally stomach contents contain the cubic centimeter of gastric juice.

For the purpose of making a filtrate may be diluted 10, 20, 40 and of each of these dilutions is placed amounts of ricin, sodium chloride, small test tubes appropriately numbered. These tubes are taken from the deposit noted according to the time when the deposit has disappeared in the noted in these tubes the precipitate in excess when absent in dilute juice secretion the use of 2 or 5 times may be necessary.

The technique as ad-  
The filtrate of the Ewald  
the free hydrochloric acid  
according to the degree  
100 or 1 to 10,000; and  
estimation is made by  
been added 2 cubic cm.  
cubic centimeter of  
added 1 cubic cm.  
of the gastric juice  
0.9 cubic centimeter  
0.5 cubic centimeter  
peptic activity  
proportion of

To tube cubic centimeter. The tube hours, an fraction diluted activity dilution activity of the solution. Using a 1 cubic centimeter pipet add 0.5, 0.8, 0.7, 0.5, 0.0 cubic centimeters of water to a series of five small test-tubes about 1 centimeter long (any test-tubes will do as well.) To each tube is added 0.1 cubic centimeter of 0.6 per cent. HCl, and 1 cubic centimeter of the edestin solution.\* The edestin is promptly precipitated as a very fine precipitate that soon becomes flocculent. Add 0.15 cubic centimeters of diluted gastric juice to the second tube, 0.2 cubic centimeters; to the third, 0.3 cubic centimeters; to the fourth, 0.5 cubic centimeters; and to the fifth, 1 cubic centimeter. A sixth tube containing 1 cubic centimeter of water, 1 cubic centimeter of the edestin, and 1 cubic centimeter of

absorption of 9.1 per cent as a matter of economy. A liter of gastric juice, gives a normal peptic number, and is capable with traces of undigested protein.

" be added as a control. The total volume  
The contents are mixed by stoppering  
and the tubes are then placed in a  
series. Table I gives in condensed  
form the results ready for digestion.

DE DIGESTION IS SET UP AND  
EACH TUBE,

	1	2	3	4	5
.....	0.85	0.8	0.7	0.5	0.0
.....	1.0	1.0	1.0	1.0	1.0
.....	1.0	1.0	1.0	1.0	1.0
Centimeter	0.15	0.2	0.3	0.5	1.0
	133	100	67	40	20

After a 15-minute period, the tubes are removed from the series, the contents are mixed by inverting as before, and the tube is again placed in the series in the least amount of gastric juice, and in which case no digestion occurs, as indicated by the fact that no precipitate (or only a very slight one) is formed. The peptic number, which is taken as an index of the amount of pepsin present, is calculated as the greatest number of centimeters of 0.1 per cent. edestin solution that will be cleared up by 1 cubic centimeter of undiluted gastric juice acting for 15 minutes at 37° C. Hence,

$$\text{Peptic number} = \frac{\text{Dilution of gastric contents} \times \text{c.c. } 0.1\% \text{ edestin used}}{\text{Smallest number of c.c. of diluted contents causing complete digestion}}$$

One cubic centimeter of 0.1 per cent. edestin is always used in each of the series.

$$\text{Peptic number} = \frac{\text{Dilution of gastric contents}}{\text{Smallest number of c.c. of diluted contents causing complete digestion}}$$

For example, if digestion occurs in Tubes 2, 3, 4, and 5, but not in Tube 1, according to Table I, the

$$\text{Peptic number} = \frac{20}{12} = 1.7$$

the gastric contents have been diluted 1:20. The peptic number is readily obtained by reference to the bottom line of Table I. The peptic analyses recorded in Table II are plotted in Figure 12 against HCl, and show that for instance when the concentration of

Ewald test breakfast the normal peptic number by the method proposed is 67 to 100, which happens to be a little more than twice that of the pea globulin method of Givens.

TABLE II.  
SHOWING RESULTS OF DETERMINATIONS MADE BY THE PROPOSED METHOD.

CONTENTS Subject	Date	FREE HCL (%)	TOTAL HCL (%)	PEPTIC NUMBER Rose-Givens	NUMBER Edestin Method
P. R. F.	3/25/18	68 (0.25%)	93 (0.34%)	42	100
P. R. F.	3/26/18	50 (0.2 %)	71 (0.26%)	42	100
P. R. F.	3/27/18	60 (0.22%)	82 (0.30%)	42	100
F. H. F.	3/26/18	28	40	42	100
R. C. L.	3/26/18	56	65	31	67
R. C. L.	3/27/18	80	91.5	42	100
G. H.	3/27/18	21	29	18	40
R. C. L.	3/29/18	61	74		67
O. K.	3/30/18	40	56		67
X.	4/ 4/18	—	—	—	100
P. R. F.	11/25/18	—	—	—	67*

\* Four determinations of the peptic number were made in this case, using ~~each~~ of the four samples of edestin, respectively (cf. Table I). Identical results were obtained.

"The method proposed for the preparation of edestin gives a product of sufficient uniformity to be used in the estimation of peptic activity without the necessity of ascertaining its exact edestin content. The procedure for determining peptic activity gives a clearer end point than that of the pea globulin method, less protein is required, and the method, even to the preparation of the edestin, is very practical for clinical use."

"Chymosin and Chymosinogen."—In clinical work when the acid-pepsin secretion is normal or high it is surprising to note how accurately the secretion of this supposed enzyme corresponds with that of the proteolytic ferment (and it is mainly for this reason that I doubt the existence of a specific milk-curdling ferment). In the comparative estimations of over 700 test-meals for the proteolytic and the milk-curdling powers (in which the Mett and the milk tests were employed), it was proven that they ran so closely together that it seemed that the milk curdling tests are only the tests of a partial proteolytic action, which the Mett and Jakoby-Solms prove to its termination. In diseased conditions of the stomach and those of general illnesses, much variety of the stomach secretions is observed. The main digestive secretions of the stomach,

namely, hydrochloric acid and pepsin (chymosin), are liable to show a ratio change in ways which suggest that the HCl secretion is the most easily, quickly, or markedly affected, and the pepsinogen (pepsin) somewhat less so. Because of the ready sensitiveness of the HCl secretion to changes in corporal conditions (as well as gastric), quantitative changes of the acid are not of as much diagnostic significance in gastric conditions as is that of the enzyme, and thus changes in the quantity of the ferment are truer indices of stomach disease than are changes in the HCl content, although for thorough work both should be quantitatively tested in each instance. It is not uncommon to obtain (particularly in some of the mysterious neurotic conditions) achlorhydric filtrates in which but little thorough peptogenic power is present (but which show a full quota of the milk-curdling power) in patients in whom test-meals removed a short time afterward show the first mentioned to be normal. On the other hand, in organic diseases of the stomach, an absence or a decrease in the milk-curdling power is always accompanied by the same loss in the other more sensitive gastric secretion. For this reason, tests of this possess value in the diagnosis and prognosis of stomach disease, and it is fortunate that these tests are so easily performed.

The specific action of "chymosin" (pepsin) is upon milk, the casein of which is coagulated. It is interesting to observe that while during the process of digestion in the normal stomach this enzyme is active in an acid media, and the secreted free HCl serves to activate its proferment, still, full activity through the milk-curdling phase can be noted in a neutral or alkaline media when any one of the soluble calcium salts had been added. For this reason, tests for this power of pepsin are of decided value in alkaline vomitus, and where we may wish to note whether this contains the main constituent of the gastric juice or not.

**Qualitative Test.**—Five or ten cubic centimeters of milk are treated with a few drops of gastric filtrate and kept in a water-oven at 37° C., or the tube placed in a glass of warm water for 15 minutes. If coagulation takes place, pepsin is present. If not, the milk is treated with 10 cubic centimeters of feebly alkalinized gastric filtrate (rendered so by adding sodium hydrate, or sodium carbonate solution and testing with red litmus paper), and 2 or 3 cubic centimeters of a 1-per-cent. solution of calcium chloride are added. This is put through the same heating process as above mentioned, and in the presence of the zymogen a thick cake of casein will occur.

**Quantitative Method.**—The method is based upon the fact that on gradually diluting the gastric filtrate an extent of dilution is finally reached at which the curdling reaction is no longer obtained. Under normal conditions this for the ferment is between 1 to 30 and 1 to 40,

and for the artificially activated proferment between 1 to 100 and 1 to 150. In making an analysis of the ferment the gastric juice is neutralized with a very dilute solution of sodium hydrate (the decinormal solution answers well), and 5 cubic centimeters of the filtrate is placed in each of several tubes. The first is employed without dilution, the second diluted 10 times, the third 20 times, and the fourth 30 times with water. To these an equal amount of neutral milk is added corresponding to the total amount of the gastric juice, or gastric juice dilution in the various tubes. These tubes, properly labeled, are placed in the water-oven and kept for 15 minutes at a temperature of 37° C. and the degree of coagulation noted according to the dilution. Because in the high dilutions much fluid is contained in the tubes it is best to perform the test by placing 5 cubic centimeters of milk in each of several tubes, and to this add the neutralized pure juice, and the various dilutions in 5 cubic centimeter amounts; in this way all of the tubes have the same quantity of mixture.

Since with a given gastric filtrate one cannot foretell the results of the reaction, should it be found that the end-reaction is present only in the pure juice or a low dilution (and would require the performance of the test over again), it is best to activate all of the ferment substance in the first instance in each quantitative analysis. For this reason I would advise the following as the steady routine for the estimations: In 5-cubic-centimeter lots, the pure juice and the dilutions up to 140 should be placed in the various tubes. To each of these are added 5 cubic centimeters of neutralized milk and 3 cubic centimeters of a 1-per-cent. sodium chloride solution, and the observation made as above described. Where steady work with gastric filtrates is being performed, I would advise the use of a simply constructed test-tube stand to hold eight tubes of about 15 or 20 cubic centimeter capacity. The tubes themselves can be permanently marked with diamond ink, or the base of the standard labeled to correspond to the dilutions in each tube. Such a stand can be used in an oven and is most convenient. Milk-curdling estimations are only tests of the pepsin content, and being so much easier to perform than the Mett, Hammerschlag, and the Jakoby-Solms they can readily be utilized in clinical work for this purpose.

**Lipase.**—It is now definitely settled that lipase is a normal constituent of the gastric juice. Being present in such small amounts in the stomach contents and being difficult to accurately estimate quantitatively, the tests for it are subordinated in value to those for the pepsin and the hydrochloric acid estimations. In instances in which a milk or a diet liberal in fats may be indicated in individuals who complain of an intolerance for these substances, tests for lipase may be performed.

After an experience with several of such persons (in all of whom I have found lipase always present), I believe that this intolerance really exists, but that it is due to the mechanical effects of tough milk curds or fat upon the pylorus and stomach, and not to an absence or diminution of the fat-splitting ferment. In achylie conditions, the gastric lipase content falls with the other stomach digestive secretions, but it is not uncommon to see a relatively higher lipase content than would be represented by the other gastric secretions. This has always been interpreted by me as a lipase addition by regurgitation from the duodenum (such as may be possible with disturbance of the pyloric reflex in the neurotic or secretory conditions, or possibly in the direct way from primary or secondary atony of the pyloric bundle of muscle fibers). The demonstration and quantitative estimation of lipase have already been described in this chapter. To be sure that such lipase as may be present is from the stomach itself, it is essential that a thorough washing of the organ be performed, and that the test-meal following it be free from fat (the lactic acid free meal of Boas answers well).

#### EXAMINATION AND SIGNIFICANCE OF GASTRIC MUCUS.

The mucus in test-meals is found both incorporated with the substance of the meal and in a free form which floats in masses or gaseous clumps on the surface of the fluid. The first is the gastric mucus which had been secreted by the glandulature of the stomach combined with the mucin constituent of the saliva, and the second the secretion from the mouth or pharynx incident to the passage of the stomach tube. The latter can be recognized with the naked eye, and since it is of no significance in diagnosis it should be skimmed off.

Test-meals from normal stomachs contain too small amounts of mucus to recognize its presence by the naked eye, excepting by the degree of viscosity it imparts to the return. When a glass rod is drawn through such meals it can be withdrawn quite free of adherent substance, although usually more amylin adheres to the rod drawn through test-meals from normal stomachs than meals pathologically deprived of a normal amount of mucus content. In the majority of cases of chronic gastritis, the glass rod can drag up a string or clump of incorporated mucus, whereas in cases of increased HCl secretion and in complete atrophic gastritis the meal is often so fluid that the rod is withdrawn clean not only of mucus, but also of the carbohydrate test-meal substance. Unless such as are enumerated above are plainly evident, no fixed conclusions of diagnostic import can be drawn from the macroscopic examination of mucus alone, for cases of more or less atrophic or sthenic gastritis, for instance, may

display an increased mucus, and others again a very low content; and this is likewise true of ulcer, cancer, and the benign affections.

#### ANALYSIS OF PRODUCTS OF ALBUMINOUS DIGESTION.

Since proteid conversion depends upon the presence of hydrochloric acid and pepsinogen, tests for the various proteid bodies are not important in clinical work, and because the various proteid bodies are present in a more or less complex mixture and the tests for each of them comprise much laboratory detail, they are but rarely performed. Qualitative tests for syntoin, pro-peptone, and peptone are found elsewhere. The separation of the various albumoses may be performed as follows:—

A known amount of the gastric filtrate is carefully neutralized with a dilute solution of sodium hydrate, at which the syntoin in present will be precipitated. The specimen is filtered and the deposit on the filter paper with the paper itself (which had previously been dried and weighed) is tested, or dried and weighed; this gives the amount of syntoin. The filtrate is then rendered feebly acid with dilute acetic acid, treated with an equal volume of a saturated solution of common salt, and brought to a boil, at which the native albumin in present will be coagulated and can be filtered off on cooling. The deposit on the filter paper is weighed, as before described, and gives the amount of native albumin present. The next step is to obtain the albumoses and peptones that remain in the filtrate. The albumoses are obtained by treating the filtrate with a concentrated neutral ammonium sulphate in excess and permitting it to stand for twenty-four hours at which full precipitation of the albumoses takes place. When these have been filtered off, the filtrate contains the peptones which can be demonstrated by the addition, drop by drop, of a 2-per cent. solution of cupric sulphate, at which a rose or a purplish-red color will develop (biuret test).

#### ANALYSIS OF PRODUCTS OF CARBOHYDRATE DIGESTION.

The test for the degree of starch conversion is not of much help for diagnosis. The main reason for this is that all types of these bodies from starch to sugar are usually present, causing a complex color. In absence or diminution of salivary secretion, the blue color with iodine may be most helpful in suggesting these states, and a very light-yellow might suggest a low acid-enzymotic secretion in the stomach. An occasional suspicion of hasty eating and incomplete

salivation as being a factor in the production of gastric distress may be obtained by these tests.

The various stages through which starch passes to the end sugars are demonstrable by the different colors in starch and erythrodextrin tests, and absence of color in achroödextrin and the sugars that are noted when such substances are treated with a solution of iodopotassic iodide (Lugol's solution). With hydrated starch this strikes a blue, and with erythrodextrin a mahogany brown. Maltose and dextrose are best tested for by means of Fehling's or Nylander's solution.

To note the status of starch digestion a few cubic centimeters of gastric filtrate is placed in a dish, diluted with water, and a drop of Lugol solution is permitted to run down the side of the vessel into it. Filtrates from normal stomachs usually display a dark-brown coloration; and when the starch conversion has been low, a deeper brown with a bluish tinge may be noted. A deep yellow or light brown always suggests a high conversion.

#### TESTS OF THE MOTILITY OF THE STOMACH.

A knowledge of the motor condition of the stomach is of vast importance in the diagnosis and therapeutics of gastric disease. Of the causes of insufficiency two main divisions may be made: firstly, a weakness of the expelling force; and secondly, an obstruction to the emptying of the organ.

For the first of these there may be mentioned as factors in its production: the gastric causes, prolapse, habitual overeating and drinking, malignant ulcer, organic disease affecting the body of the organ, long-standing neurotic conditions, primary atony, etc.; and the constitutional causes of toxemias, particularly from systemic disease or disease of special organs other than the stomach, and lastly debilitated states of the body.

The various conditions in which mechanical obstruction to the exit of chyme exists may be divided into the gastric and the extra-gastric causes, in both of which the obstruction may be situated in the pyloric region or at the pylorus itself. Among the conditions confined to the stomach can be mentioned carcinoma, cicatricial contraction following ulcerated conditions, thickening of the pyloric musculature in hypertrophic gastritis, perigastric bands, pedunculated-benign growths in the cavity of the stomach encroaching on the narrow pyloric region, lymphocatricial masses (following ulcer), usually beginning in the deep layers and extending beyond the organ and by virtue of their

size pressing the pyloric region forward, and lastly a congenitally narrow pylorus. Among the extragastric conditions may be enumerated tumors and adhesions near the pylorus involving the gall-bladder, liver, small and large intestine, pancreas, kidney, large or displaced spleen, herniae, volvulus, etc.

**Test-Meals and the Chemical Methods.**—Repeated investigations have proven to me that the motor function of the stomach is best tested by means of foods which in kinds and quantities should leave the stomach in certain lengths of time—namely, by means of test-meals. As compared to the various chemical measures in which the great uncertainties of time for dissolving, absorption, and excretion in the urine and saliva of the ingested substances are encountered, the test-meal methods are the direct, more accurate, and truer physiological means.

In the efforts to get away from the unpleasant features of the use of the stomach tube, various observers, taking advantage of the fact that certain chemical substances dissolve or are split up in alkaline medias and not in acid, have advanced methods for testing the motility of the stomach that are so far removed from physiological lines that the use of them all should be discontinued. To illustrate this, it is sufficient to recall that catgut, with which the Sahli bag is tied, may dissolve in the small intestine as well as in the stomach.

In the ingestion of chemical substances, which should be absorbed from the alkaline small intestine and not from the acid stomach, as a means for testing the stomach motility just as much inaccuracy may exist. It has long been taught that digestion in the stomach is accomplished solely by the gastric and mouth secretions, and that only in pathological states could bile, succus entericus, and pancreatic juice be present. Parlow, however, has called attention to the possibility of pancreatic digestion in the normal stomach, especially after the introduction of oils. According to Boldyreff,<sup>20</sup> under certain conditions, considerable amounts of pancreatic secretion together with bile and intestinal secretion make their way into the stomach and are concerned in the activity of gastric digestion. In some of the many aspirations of the empty morning stomach I have performed in the search for organic elements in gastric contents, the presence of the intestinal secretions were not rare findings even in non-pathological conditions of the organ. In the low secretory and particularly in atonic conditions (both of which comprise the great majority of gastric cases), such morning findings were not uncommon, and in my opinion enough attention has not been given to this fact, which, as Boldyreff has said, is not occasioned by a chance reversed peristalsis of the bowel; here then is another element of inaccuracy in the chemical

methods of noting the gastric motility. Added to it, are those connected with the "package methods" already mentioned, the circuitous route these chemical substances must take before elimination, and the presence of pathological conditions affecting absorption from the intestines in the first instance, or elimination from the delivering organs in the last. These are my reasons why the salol, iodoform, methylene blue, iodipin, or other methods, are not included or advised for use, since the line between gastric and intestinal digestive processes is not sharp enough to warrant accurate deductions from their use in the tests for HCl secretion, or the absorptive and motor tests.

The significant factors pertaining to the diagnoses of the common conditions of motor disturbances of the stomach, as gleaned from the examination of test-meals, can be found in connection with the description of the different forms of test-meal (Chapter VI), and the macroscopic and the microscopic examinations of same, found at the beginning and conclusion of this chapter.

**Food Remnants Obtained by Means of Morning Lavage of Meals Taken the Evening Before.**—For the purpose of distinguishing in cases of dilated stomachs whether the dilatation present is secondary to pyloric stenosis or primary in nature, the lavage of the morning stomach after a heavy meal taken the night before has been practiced for years. In high degrees of pyloric stenosis the morning stomach usually contains more or less food remnants, usually those of the indigestible vegetable substances (skins, seeds, etc.), whereas on the other hand, when the exit of the stomach is patent, even in high degrees of gastric atony, the morning stomach is empty of foods. This method of examination must be considered in the same light for diagnosis as an eight, nine, ten and so on hour extraction of a mixed meal. No digestion takes place during the night, or during sleep, or with the body in a recumbent position, that makes the method any more valuable than if the same kind of a meal were taken and the stomach washed, both on the same day. Its utilization, however, has phases of convenience that make its consideration well worth the while. When the examination of the Ewald and mixed meal shows the existence of a stagnant condition of the organ of a high degree, rather than extract a series of mixed meals, at say, eighth, tenth and twelfth-hour intervals, it expedites matters to advise the taking of a dinner consisting of the various commonly eaten food articles at eight or ten P.M., and the lavaging of the organ in the morning, at say, eight, ten, or twelve hours afterward.

It must be evident, that in a high degree of stagnant condition of the stomach, the gastric distress incurred by the taking of such a heavy

meal, or the vomiting of it that is liable to follow when its fermentation and irritation take place, is very apt to cause the patient a restless and sleepless night; or the meal may be vomited and lost before morning. For these reasons it has been my custom to control the quantity of food taken and advise the ingestion of the regular Riegel meal in the evening at ten; or, better yet, to employ only such substances for the evening meal as, by virtue of their high cellulose content, are not digested and thus would "drag" in the stomach, and still would pass through a stomach tube in washing for them; for these examinations I have now limited my practice to the use of prunes or raisins (cooked or raw). A small dish of these articles can be eaten in the evening at a specified time and the skins and cellulose substance of them readily obtained in the morning. In the examination of the lavage water in these instances the employment of the author's straining sieve, described elsewhere, is convenient.

A word of caution must now be said on drawing conclusions for or against pyloric stenosis from these examinations alone, which, next to "late collective vomiting," may be classed as the most valuable measures we now have for the diagnosis of stenotic conditions. The perusal of the following history of a case in point is offered as of interest:—

G. S. R., 48 years. Intelligent man. Writer by profession. Widower. Mother died at 66, of pneumonia; father at 71, from an "accident." Habits good. Highly neurotic in nature.

*History.*—Twenty-five years before, when weighing 180 pounds, began to have pains in the stomach-region of a gastralgic type. The attacks came on periodically, lasting one or two weeks at a time, with an interval of complete cessation between. During the attacks the pain was most acute (requiring morphine), and was accompanied with vomiting and much gaseous distention of the stomach. His weight gradually ran down to 150 pounds until one and one-half years before I saw him when he contracted typhoid fever. After the typhoid his gastric attacks came more often and were more intense in character; he had distinct collective vomiting, sometimes vomiting foods eaten two days before, and as much as two quarts at a time. At times he vomited very seldom—"Providing I was not nervous at the time when I would be seized with a violent pain in the stomach during a meal, I would get these attacks for no known reason and when begun I would be worse again for two or three weeks." In the past one and one-half years, lost 68 pounds in weight, and once lost eight pounds in ten days. For a space of three months since the typhoid he improved marvelously and regained 40 pounds of lost weight, only to lose it again afterwards. Carried a stomach-tube in his pocket which he passed upon himself to empty his stomach and relieve his gastric distress during the painful seizures. Was mildly addicted to the use of morphine.

*Physical Examination.*—Weight, 108 pounds; anemic and attenuated in body; plainly a neurasthenic. Stomach seven centimeters below umbilicus and enlarged in all directions; gastric peristaltic waves plainly visible; gastric splash sounds marked; an indistinctly-defined mass, small in size and situated deep in the epigas-

trium; pressure on the epigastrium painful, and gave him nausea. Ewald meal showed 180 cubic centimeters return, a low carbohydrate conversion, a high HCl secretion and a total acidity of 140°, and increased mucus. He ate a large dish of prunes and raisins at ten o'clock in the evening, and the stomach was washed the next morning at 9 o'clock. The lavage water contained nothing but a few rolls of mucus (no vegetable substance whatever).

Operation the next day. The anterior surface of the pyloric region and body of the stomach normal. No metastases or adhesions. A mass about the size of a child's fist was disclosed back of the pyloric region, pressing both walls of the pyloric region forward, but not actually involving the pylorus itself. Its deep situation precluded its extirpation, a gastro-enterostomy being performed with successful results in the patient's local and general improvement.

The above case shows that a stenotic condition must be marked at or very near to the pylorus itself to give results from this method of examination. I have observed two cases of perigastric bands binding down the pyloric region (when the stomach was also immensely dilated) that failed to give results from this method of examination, and thus it is that one should be careful not to be too hasty in decreeing the absence of stenosis from negative returns.

**Roentgen Ray—Mixed Meal Method of the Author.**—In cases in which the use of the stomach tube is contraindicated, refused, or when for any reason we wish to avoid its use, a method of noting the motility of the stomach is here advanced. The method is based upon the fact that the insoluble bismuth salts leave the stomach with the component foods of the Riegel meal—or any mixture of foods in fact—in about normal times. In normal stomachs and under favorable conditions, about 25 grams of bismuth subcarbonate or 32 grams of bismuth subnitrate ingested at the time of the taking of a Riegel meal and the stomach observed by X-rays five hours afterward, will just about show a shadow corresponding in limits to the upper and lower border of the pyloric region, while the body and fundus of the stomach will not cast a bismuth shadow. At six hours and later, the stomach will be emptied of both the bismuth and the food contents and the stomach area will not be discernible.

The method is simply performed. In the morning preferably, a Riegel meal is taken quickly followed by a glass of kephyr, zoolak, or kumyss, or a plate of apple sauce in which the bismuth salt had been mixed. The observation by means of the Crookes tube and fluoroscope screen, or X-ray plate, is made at three, five, seven and so on hours afterward, and the time noted when the bismuth has left the organ.

When the bismuth in the small intestine does not interfere with the observations, it may be noted that a stomach shadow may not be

seen in one or two hours in cases of hypermotility, be distinctly marked in seven and nine hours afterward in delayed motility from any cause, and in marked pyloric stenosis it is usual to observe a deep general stomach shadow as late as twelve or more hours after ingestion. In some of my cases of a high degree of malignant stenosis of the pylorus, the stomach shadow could easily be noted three days afterward and for two days longer even in spite of two washings of the organ.

Stomach motility is now well enough estimated by the ordinary X-ray technique, namely that six hours after the taking of barium it should all have left the stomach when the motility is approximately normal and the pylorus patent. Care should be exercised that small residues (such as met with in ptosis) are not construed as definite stagnations of surgical degrees. This simple observation can be made fluoroscopically.

#### MICROSCOPIC EXAMINATION OF THE GASTRIC CONTENTS.

The microscopic examination of the stomach contents often gives most valuable diagnostic information. The findings of importance are the abnormal constituents in the fluid of the fasting stomach, the noting of alterations in the normal conversion of foods during the process of digestion, and the bacteriological findings in both the food-digesting and empty organ. Much of the information on these has been described elsewhere in this volume, and this section will concern itself more particularly with the technique of the examinations.

**Mucus.**—The fluid obtained from the fasting stomach is usually food-free, consisting mostly of mucus, detached squamous cells from above the cardia, leucocytes, free nuclei which are derived from the normal cellular elements the protoplasm of which had digested down to the more resisting nuclear membrane, and occasionally the so-called mucus spirals. All of these may be readily recognized by the low power, and, excepting the free nuclei, without the addition of a stain. A preparatory staining may be advantageous at times, and for this any of the commonly used ones may be employed. When much mucus is present, it is often best not to fix the slide with heat but to do this with plain wood alcohol.

If gastric juice containing mucus, hydrochloric acid, or large amounts of yeast fungi be permitted to stand for a while, small tapioca-like bodies will collect on the bottom of the vessel, which, upon microscopic examination, will be seen to contain numerous spherical snail-like formations of mucus occurring either singly or collected in clumps. They are of no special pathological significance. Mucus

self can be recognized through the microscope by its fibrillary character and by having corpuscular elements and myelin drops in its substance. The myelin drops are not stained by the dyes. Mucus is dissolved by alkalies, and not by acetic acid.

**Cellular Elements.**—In atrophic conditions of the glandulature, in addition to the above, the morning stomach often contains free cellular elements from the gastric tubules. These are obtained in the aspirated contents, or from saline instillations into the stomach, and

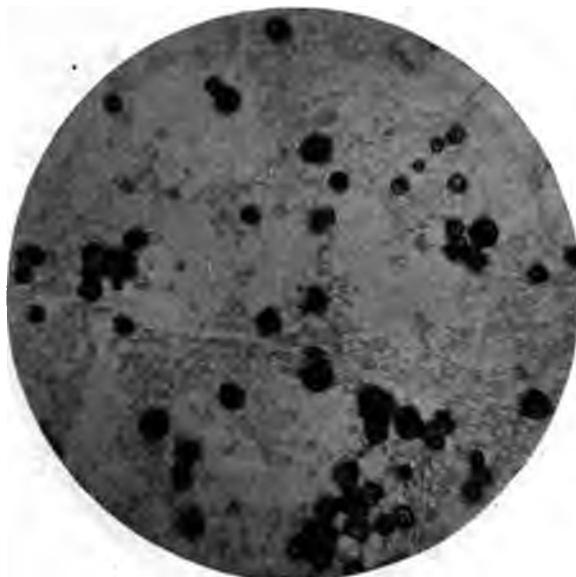


Fig. 48.—Photomicrograph of the contents of a fasting stomach showing marked growth of the yeast fungi and mucus spirals. Stained with aqueous eosine.  $\times 900$ .

are of much value in diagnosing atrophic gastritis. When present in these conditions, the acid or parietal tubule cell is the more easily recognized because its entire protoplasmic body stains with a fine stippling of granules and its nucleus is prominent. The central cells are not so prominent because they take up the aniline stains but very poorly (with the nucleus of them better results are obtained). By patient search, however, their long oval nucleus with a more or less distinct shred of cell protoplasm—not stippled—may be observed. In atrophic gastritis the epithelium of the stomach is also shed, and the columnar cells may show themselves singly or in numbers in a regular alignment. Other cellular elements commonly seen in chronic

gastritis are large numbers of leucocytes, which can be readily recognized by their cellular and nuclear characteristics. In these conditions also, the number of free nuclei are prominent features of contents. Occasionally, a cellular cast of the gastric tubules may be seen with the cells in regular mass formation. Goblet cells from epithelium are not rare findings, and are not of much significance unless present in distinctly increased numbers. Care must be taken that the columnar cells observed and considered gastric are not those

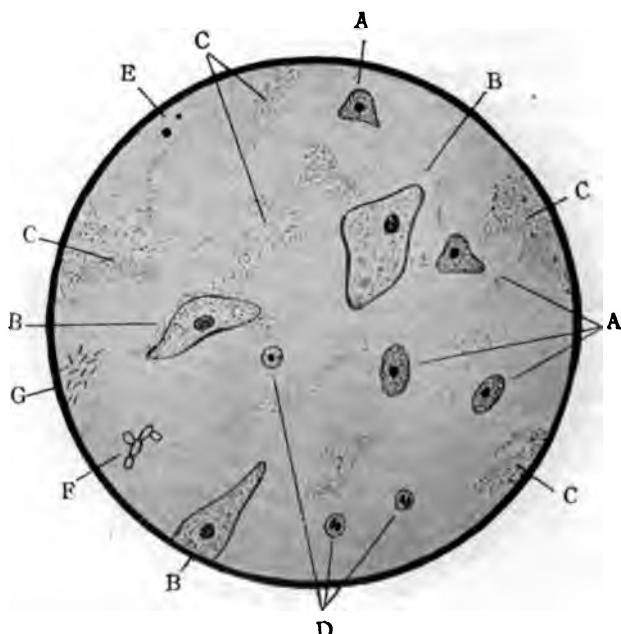


Fig. 49.—View through the microscope of the sediment from a case of atrophic gastritis. *A*, Acid or parietal cells. *B*, Squamous epithelium. *C*, Free nuclei. *D*, Leucocytes. *E*, Mucus from stomach. *F*, Yeast fungi. *G*, Bacilli.  $\times 460$ .

from the respiratory tract which have been swallowed; these can often be recognized by their cilia and subcilia and their infrequency.

When the instillation method is being employed, the return should be allowed to settle and the lower regions centrifuged. Several different methods of staining may be employed, but the commonly used one for staining blood and tissues answers best— $\frac{1}{2}$  per cent. eosin 1 per cent. alcoholic (wood) solution of hematoxylin (Bohmers). After dry the slide is fixed by heat (passing through the flame three times).

or by flooding with wood alcohol and thoroughly drying. The eosin is used first for two or three minutes, the slide then swilled in water, and stained while wet with the hematoxylin solution. This method of staining usually colors the acid cells red, and the central and epithelial, as well as all others, a blue. Biondi's polychrome, aniline, gentian-violet, or others, may be used to bring the cells out prominently. An amplification of about 500 diameters is desirable.

**Food Remnants.**—These are obtained by direct aspiration, or better by lavage of the stomach a definite number of hours after a meal



Fig. 50.—Photomicrograph of a portion of a dinner from a case of marked primary gastric atony extracted several hours after ingestion. Shows mostly vegetable substance, fat droplets, meat fibers, and amorphous material. X 70.

when the stomach normally should be empty or have only a few stray remnants. By the lavage method most of the larger particles could be collected on the surface of a sieving screen (if this is between 60 to 100 wires to the inch), and could be readily seen by the naked eye. When this is not used, or the particles very few or fine, the lavage return should be permitted to stand for an hour or so, the supernatant clear fluid drawn off, and the dregs placed in a conical glass until the food substances settle. The sediment should then be drawn out by means of a long pipette, and examined in the fresh and wet state with a low power.

The red meat fibers are seen with a more or less separation of their fasciculi, depending upon the motor activity of the stomach and upon the degree of acid-enzymotic secretion. They are seen as large-sized, reddish-colored columns displaying fine transverse striations. The starch is observed all the way from the characteristic kidney or oyster-shaped granule having a hilum and striations from it, to the loose amorphous matter which has been freed from the interior of the granule. The process of starch digestion may morphologically be

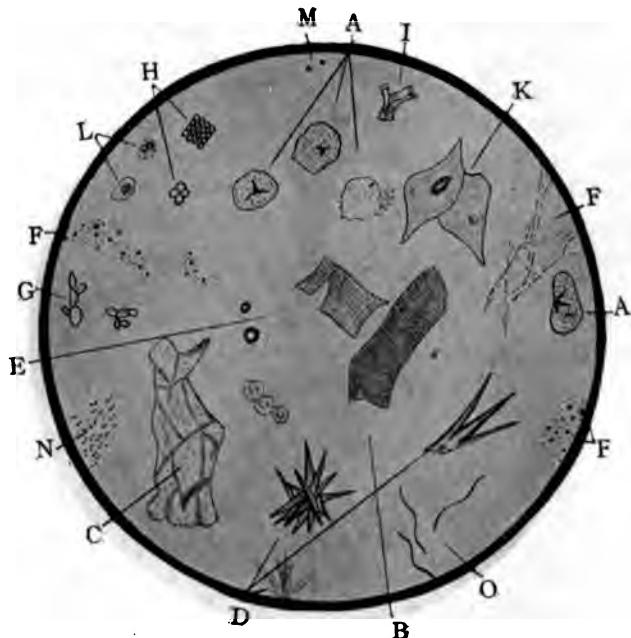


Fig. 51.—Microscopic view of a part of the contents of a stomach from a case of extreme gastric myasthenia following typhoid fever. The picture represents particles of a dinner taken six hours before and an Ewald test-meal taken one hour before. *A*, Starch granules in various stages of digestion. *B*, Striated meat fibres (beef). *C*, Vegetable substance. *D*, Fatty acid crystals. *E*, Fat droplets. *F*, Mucus and mycelia. *G*, Yeast fungi. *H*, Sarcinae. *I*, Columnar cells from pharynx. *K*, Squamous epithelium. *L*, Leucocytes. *M*, Isolated nuclei. *N*, Diplococci. *O*, Leptothrix buccalis.  $\times 400$ .

described as: first, the granule, which, through absorption of water, swells, loses its hilum shape and striations; then a rather stippled round body with a two or three-armed dark remnant of the hilum; then a globular sphere less distinctly stippled and with thinner membrane; and, finally, the bursting of the latter freeing the amorphous starch matter from the interior. The other vegetable substances are seen in a great variety of formations, both in their cellulose make up and

also in the character of the contained cells. It is a fairly safe rule to follow, that any striking looking object seen, particularly when of large size and having well-marked stroma and cells, or any single cell of large or small size with confining membrane and large granule substance in its interior, are very apt to be of vegetable nature. The green vegetables, of course, have the characteristic chlorophyll color, which such articles may retain even in the feces, and this readily distinguishes them. Fat is present in one or both of two forms; these are

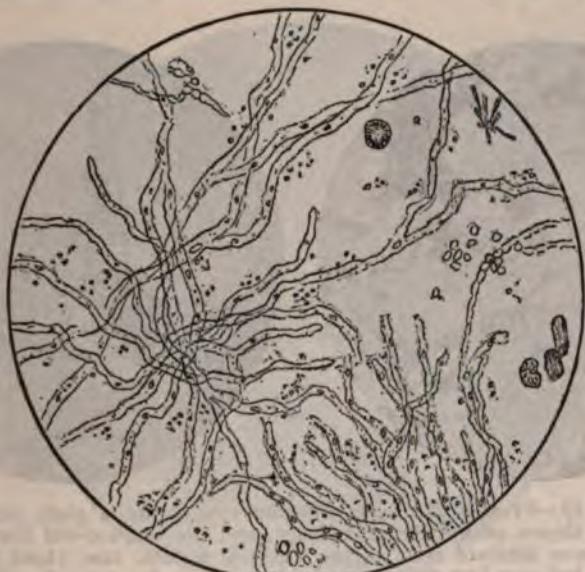


FIG. 52.—A greenish fungi found in the wash water of a stomach. Mycelia, free spores, and a few crystals.  $\times 240$ . (After Einhorn.)

the highly refractive fat droplets which may be of any size, or the fatty acid crystals. The latter can readily be distinguished by their fine needle-like rosette formations, or their arrangement in more or less regular bundles. Fatty acid crystals are usually yellow in color.

**Fungi.**—Of great significance in diagnosis is the occurrence of the various fungi in gastric contents. The commonest types of these are the yeast fungi and sarcinæ, which, under certain conditions, may be present in the stomach in enormous numbers. They usually occur together in states of gastric stagnation, and it is important to note that in gastric cancer the sarcinæ are generally absent (probably because of the absence of HCl) although the yeast bodies may be present in greatly increased amounts. The appearance of all of the

fungi is readily recognized, without preparatory staining, by 1 of a moderately high amplification.

The appearance of yeast is very characteristic, presenting its small attached oval bodies, strung out in rows with occasional arrangement at an acute angle to the parent body. Gram's iodine or L solution, or plain tincture of iodine stains them yellow. The same are smaller rounded bodies usually found arranged in one or other formations. The first is the common cotton bale form arranged in squares or tetrahedra, sometimes colorless and glistening, at

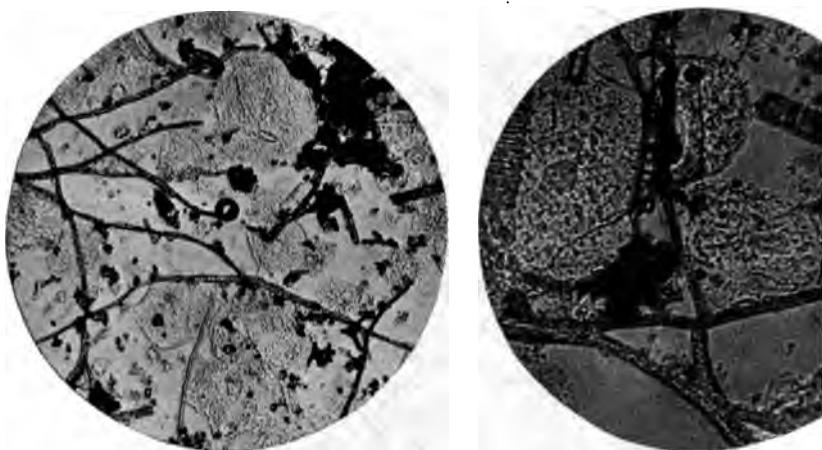


Fig. 53.—Fresh-water algae, showing two forms, a plain resemblance to the fungi shown on the foregoing page, and the bamboo-rod form. This specimen was obtained from lavage water in a clinic case (food particles showing) and was first thought to be fungi from the stomach. Close examination showed the two forms, a cellulose structure in each, and bodies which resembled mycelia to be another substance.

times a brownish-yellow. The second are the smaller sized, delicate bodies arranged more in groups like micrococci. When doubt as to their presence, the cellulose staining method suggested by this author would serve to distinguish them. This is simply performed by placing several drops of gastric contents (unfiltered) on a slide to which is added about the same quantity of the following:—

B Zinci chloridi .....	20.0
Potassii iodidi .....	6.5
Iodidi .....	1.3
Aquæ .....	10.5

With a glass rod, or the rear end of a match, a thorough mixing is made, and the slide permitted to stand for several moments.

other very thin glass slide or a large cover glass is placed upon the specimen and examined with a rather high power, when it will be noted that the starches are stained a blue and the sarcinæ a violet-red. Under normal conditions but few sarcinæ can be found; they are found in large numbers in the primary gastric atonies where the hydrochloric acid secretion is present in normal amounts or increased.

Einhorn has observed several other forms of fungi, among which he mentions a very small pellicle occurring in sparsely isolated groups, a large greenish pellicle, and a blackish pellicle occurring in long,

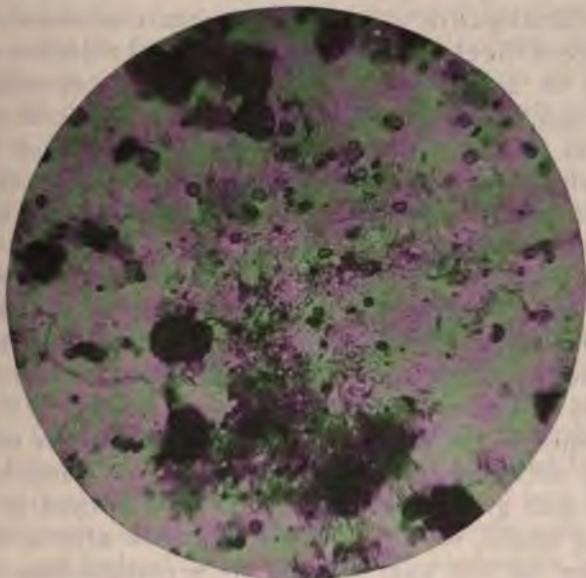


Fig. 54.—Photomicrograph of a portion of an Ewald test-meal aspirated from the stomach of a patient who had an acute gastric ulcer. The large dark objects are starch granules in various stages of digestion. Directly above the center is seen the typical oyster shell granule of raw starch with its hilum. Below the center, and elsewhere, are seen granules which had changed down to the free starch substance. Throughout the picture are seen red blood-cells. Stained with Gram's solution and eosine.  $\times 600$ .

thread-like form. These, with the yeast and sarcinæ, are vegetable substances which have been introduced from without, and when fermenting in the stomach may cause gastric symptoms until they have been removed by lavage. If tap or unfiltered water is used in the stomach and the sediment examined by microscope, certain microscopical plants (algæ) are met with. In certain seasons of the year the water may contain a large number of them, and when viewed through the microscope they very closely resemble fungi, and may be mistaken for them.

**Blood.**—The microscopic examinations of vomitus and gastric contents in which amounts of altered blood may be present usually display more or less red cells which have not lost their morphological character. Such contents are often obtained from cases of carcinoma particularly when the growth is of the soft variety, or later in the scirrhouous or colloid forms. In my opinion, the constant finding of such blood in the aspirated contents of morning stomachs (whether the traumatic form from the tube, or the swallowed forms can be excluded) are of much significance in making early diagnoses of stomach cancer.

Cases of acute gastric ulcer may be encountered in which, because of the absence of the characteristic subjective and objective symptoms the presence of an ulcer would not at first be suspected, and not until a test-meal had been examined and the blood-cells noted. In such instances when a return through the tube comes up colored by admixture with blood it is a wise precaution to immediately withdraw the tube, and satisfy oneself with the examination of such return as may have been obtained.

The red blood-cells can usually be recognized in the examination of a loop or two of the unfiltered gastric contents. For the purpose of more definitely recognizing them, however, a specimen may be dried and fixed by heat and stained with an alcoholic or aqueous eosin solution of  $\frac{1}{2}$  or 1 per cent. in strength.

**Pus.**—Since in the mass of food in test-meals pus cells cannot definitely be distinguished by the microscope, and since by lavaging the stomach such great quantities of fluid are employed in which the cells must be sought, dry aspiration or aspiration after a small saline instillation are the best ways to make these examinations. Except that which may be swallowed from ulcerative or septic conditions about the mouth, etc., pus cells regularly observed in contents from a fasting stomach are indicative of ulcerative conditions, and since ulceration commonly exists in malignant processes—even when small in size the finding of these cells is even more significant than is increased bacterial flora. Also, the finding of large numbers of pus cells in aspirations of the empty stomach or in the vomitus constitutes the most valuable single symptom we have in diagnosing phlegmonous gastritis.

If a drop or two of aspirated contents, or the centrifuged sediment of the lower zones of the saline instillation be placed upon a slide with a drop of acetic acid and a cover glass placed upon it, the pus cells can readily be observed in the specimen by using the high power lenses. They are usually seen as more or less irregularly-shaped globular bodies, about twice the size of the red blood-cell, in which one

more nuclei may or may not be seen. The apparent presence or absence of nuclei depends upon the amount of granulation; in coarsely granular corpuscles they are invisible, but are usually well-marked when the granulations are fine. Occasionally fat-globules and granules appear in the cells. With the pus cells are generally observed more or less distinct leucocytes with their sharply defined nuclei and clear protoplasmic substance. In observing the various types of cells from leucocytes to mature pus cells, it is desirable to stain one of the specimens by means of one of the basic dyes (after first drying and fixing by heat). If too long a time has not elapsed for these elements to change in form because of the water with which they have been in contact, there will be noted the following types of cells—leucocytes (usually somewhat irregular in outline); cells with fragmentation of the nucleus associated with pyknosis; a fragmentation of the entire cell with the formations of mononuclear neutrophiles; and finally a large type of cell in which only a very irregular outline may be present. Generally when pus is observed, the micro-organisms are a prominent feature in the specimen.

**Crystals.**—In vomited matter and aspiration of morning stomach contents containing bile, crystals of leucin, tyrosin, and cholesterin are quite commonly observed. These can usually be recognized by the form of their crystals, as well as by their chemical reactions. Both leucin and tyrosin much resemble the fatty acid crystals. The leucin occurs in the form of spherules of variable size, and resembles globules of fat, but differs from fat in that they are not dissolved by ether; the tyrosin (only rarely found) crystallizes in the form of very fine needles in sheave-like formations which are insoluble in acetic acid, but soluble in ammonia and hydrochloric acid; and the cholesterin in colorless, transparent plates, the margins and angles of which present a ragged appearance, and which are insoluble in water, dilute acids, and alkalies, but readily so in ether, chloroform, or benzol, and when touched with a drop of concentrated hydrochloric acid they gradually disappear, the edges assuming a yellowish-red color. Still more rarely found than tyrosin, are the oxalate crystals; these are readily recognized by their well-known square envelope shape, their insolubility in ammonia or alcohol, and their ready solubility in the mineral acids. Crystals of ammonio-magnesium phosphate (coffin lid), or magnesium phosphate may be encountered in alkaline contents.

**Protozoa** have been found in stomach contents by several observers. Among the varieties reported are the trichomonads, megastoma entericum, flagellates, amebas, and monads, two or more of which types may occur together in high degrees of stagnant conditions of the

stomach, usually of the non-obstructive type. They are to be seen only in neutral or alkaline contents, and are best sought for in aspirated contents of the empty morning stomach, which must be examined while still warm.

**Micro-organisms.**—Other than the fungi above mentioned stomach contents contain a number of bacteria, particularly in pathological conditions of the organ. The most important of the various types seen is a lactic acid producing bacillus generally known as the

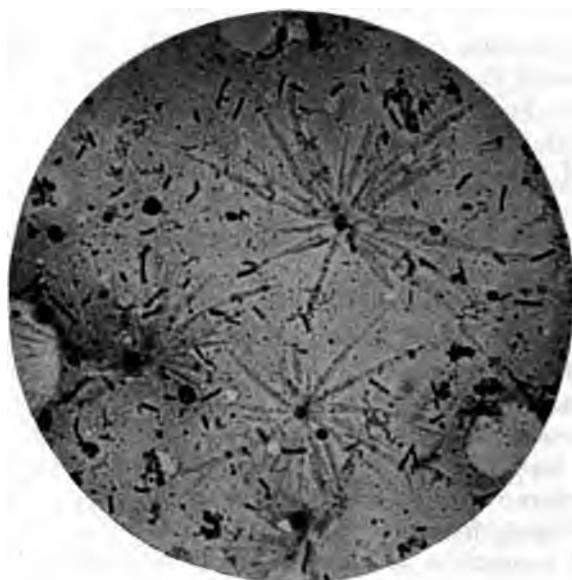
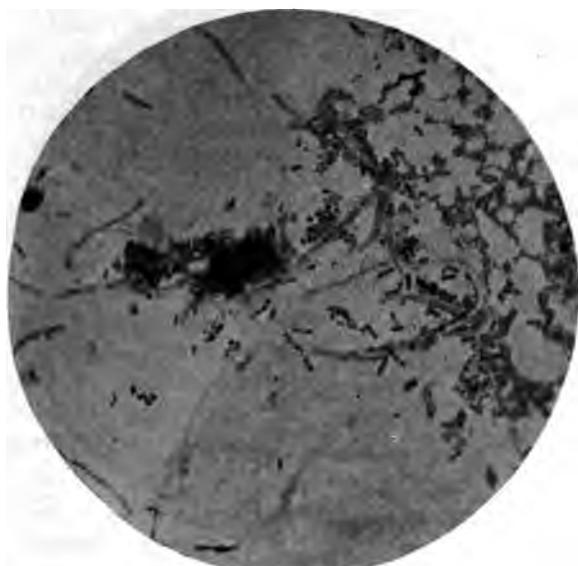


Fig. 55.—Photomicrograph of a portion of stomach contents from a case of gastric carcinoma displaying the Boas-Oppler bacilli. The stellate formations seen are a crystallization of the specimen produced in the drying, and these are sometimes mistaken for fatty acid crystals.  $\times 200$ . Stained with 1 per cent. aqueous eosine and counterstained with methylene-blue.

Boas-Oppler and also designated Fadenbazillen, long bacillus or lactic acid bacillus. These organisms occur in a number of morphologic varieties, the most common of which is an exceptionally long organism joined end to end, and arranged in long threads or zigzag lines (gigulate organism). In my experience the second common type is shorter and thicker (but still large-sized) organism, which is encountered not as numerously as the first form.

The Boas-Oppler bacillus is probably of the genus *leptothrix* and is usually met with in large numbers in stomach contents of gastric cancer when the motility and chemism (HCl) of the organ is

markedly interfered with. On these occasions, they may also be found in the mouth, esophagus, or occasionally in the intestines, to which localities they are carried from the stomach in the vomitus, or by exit through the pylorus. Careful studies of the Boas-Oppler bacilli, morphologic and cultural, strongly suggest that this organism is identical with the *B. Bulgaricus* and is not an organism (*sui generis*). The inference is drawn that in such cases it is the absence of the hydrochloric acid that allows the growth of the bacillus, and that the lactic acid is formed as the result of the activity of this organism. Contrary to saprophytes (yeast,



**case and** Fig. 56.—Photomicrograph of a portion of stomach contents from a case of gastric carcinoma showing Boas-Oppler bacilli, short bacilli, streptococci, and staphylococci.  $\times 1000$ . Stained with methylene-blue.

**sarcinae**) which can proliferate in delayed conditions of the stomach, the long bacilli require marked stagnation of the organ, and, since the dual agencies of absence of digestive stomach secretion and high degrees of obstruction are more commonly present in gastric cancer they are of much significance in the diagnosis of that disease.

When these organisms are found, lactic acid is invariably present in large amounts, proving that they are active lactic acid producers. In this connection it must be remembered, that in benign pyloric stenosis, and sometimes in high degrees of primary atony, lactic acid may be present in plainly increased amounts; but I have yet to see the stomach contents from a non-malignant case show the presence

of many of the long bacilli, and for this reason I believe be of much significance in the differential diagnosis between malignant and non-malignant conditions of the organ. The matter is size of the degree of stenosis—which is the most marked in case that of the HCl secretion, which is more characteristically malignant disease. The demonstration of the long bacilli more important diagnostic finding than of lactic acid, since only amount of gastric contents are necessary for examination, an

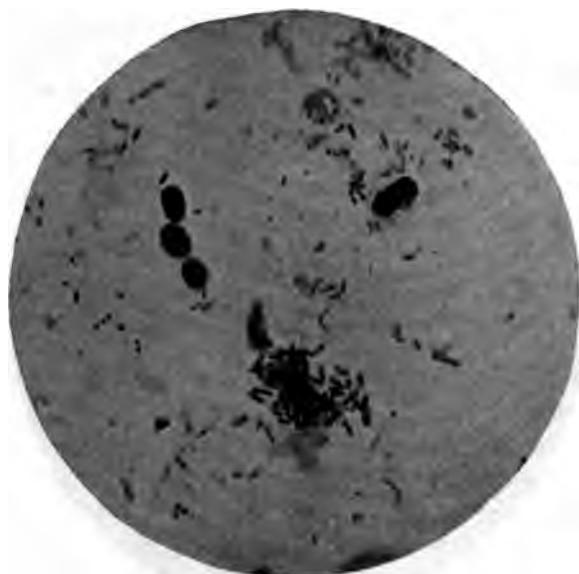


Fig. 57.—Photomicrograph of a portion of stomach contents in a case of gastric carcinoma showing a clump of streptobacilli.  $\times$   
Stained with methylene-blue.

cautions, as in the amount of lactic acid found in the contents taken in examining for them.

The bacillus is non-motile, is readily dyed by any of the stains, and is Gram positive. The commonly seen type can be recognized by the medium or high amplifications—without pressure staining—as a long glistening rod, uniform in diameter, irregular arrangement, and these in their countless numbers (usually like straight sticks) serve to distinguish them. In the staining of a drop or two of unfiltered stomach contents is spread upon a specimen dried and fixed by heat, and aniline gentian-violet, neutral blue, eosin, or other solutions used. For these, as well as for

examinations for bacteria or fungi, the unfiltered contents should always be employed.

Among the other types of organisms present in stomach contents should be mentioned the pyogenic forms (staphylococci, streptococci) occurring in ulcerated and septic conditions of the organ. In cancer situated at the fundus, in the body of the stomach or at the cardia, the presence of these micrococci in the aspirations of the empty stomach may be of much value in diagnosis. Such organisms also are present in contents from phlegmonous gastritis (usually streptococci) and chronic ulcer (usually staphylococci). In these examinations the swallowed variety from the mouth, throat, or respiratory tract must be excluded. This can only be accomplished in a relative way, since normally the mouth contains a variety of bacteria which are swallowed in the mouth secretions. The results of the examinations for them are not of significance unless the extraneously-introduced micrococci can be excluded to a definite extent, and only when a certain type of organism is always predominant, in large numbers, and in several extractions at different times. In cancer of the stomach situated extra-pyloric, I have noted in several cases the presence of a streptobacillus in large numbers. In tubercular ulceration of the stomach (which is an exceedingly rare disease), but commonly in pulmonary tuberculosis when the sputum contains large amounts of tubercle bacilli (which are swallowed), aspirations from the morning stomach often contain tubercle bacilli. These organisms are stained for in the usual ways: the pyogenic by means of methylene-blue, gentian-violet, etc.; and tubercle bacilli by carbol-fuchsin, decolorized with 5 per cent. sulphuric acid, and counterstained with methylene-blue, or the Gabbet, or Ziehl-Neelsen's methods.

In rare instances the presence of amebæ and the flagellate protozoa (particularly the trichomonas hominis) would be encountered in gastric contents. With such findings the leptothrix and spirillæ are commonly met. To observe the amebæ and flagellate protozoa fresh specimens should be examined immediately after the extraction of the test-meal and before it has become chilled and stood for a length of time; they are best observed without fixing and staining. The trichomonæ are then seen as actively motile cellular bodies, measuring from 20 to 28 microns, with a nucleus nearest the pole having from two to four flagella, a tapering of the cell body at the other end into a rear flagellum, and an undulating membrane incasing the parasite. The cell body is finally granular, which becomes coarser in the dying and dead forms; in the latter more or less vacuolation is observed. When such finding

encountered, the examination of the feces usually discloses a greater number of the parasites than the test-meal.

**Tissue Particles.**—Of great diagnostic importance is the examination of shreds of mucous membrane or tumor particles that may be found in stomach contents. It not infrequently happens in sarcoidosis and cancer that small particles of tissue are encountered in large quantities in the water, and the same may be said of chronic gastritis and cases of increased secretion of gastric juice. When these are very small in size or incorporated in blood clots, but poor results in the way of

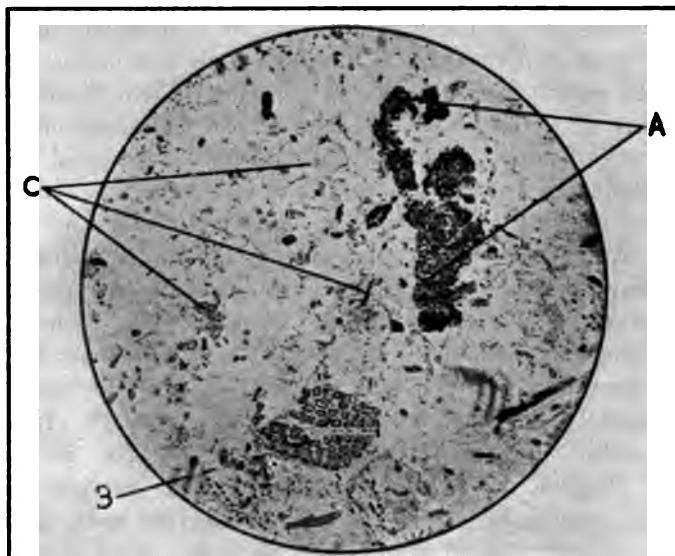


Fig. 58.—Nest of cancer cells from Case F., aged sixty-two years. Free HCl, 0; total acidity, 8. Occult blood positive. Lactic acid negative. Ova and pler-Boas bacilli not found. Wolff-Junghans reaction positive in  $\frac{1}{20}$  dilution. A, nest of cancer cells; B, bundles of striated muscle fibers from retained food residue; C, necrotic debris with streptococcal invasion.  $\times 100$ . (Lyon.)

convincing deduction are derived from the microscopical examination of them, but when of some size, they can be plainly recognized by the naked eye and are usually large enough for hardening and section, thus a detailed examination of the most satisfactory kind can be readily made.

Exfoliation of the upper regions of the glandulature of the stomach is particularly apt to occur in chronic gastritis (catarrhal ulcer). In my experience such detached particles are very small in size, colorless, and liable to escape detection; on the other hand, quite sized delicately soft, pinkish colored particles may be encountered.

is of high secretion—these appear, when suspended in a saline solution, like rather compact, small-sized, villous decidua from a pregnant uterus. In the examination of detached tissue particles from cases of chronic gastritis it is possible to note the degree of degeneration, loss and proliferation of the cellular elements, and the interstitial infiltration and extent of hyperplasia between the tubules themselves. All these are valuable diagnostic, therapeutic, as well as prognostic helps in each of these cases.

In malignant disease of the stomach (cancer and sarcoma), it is

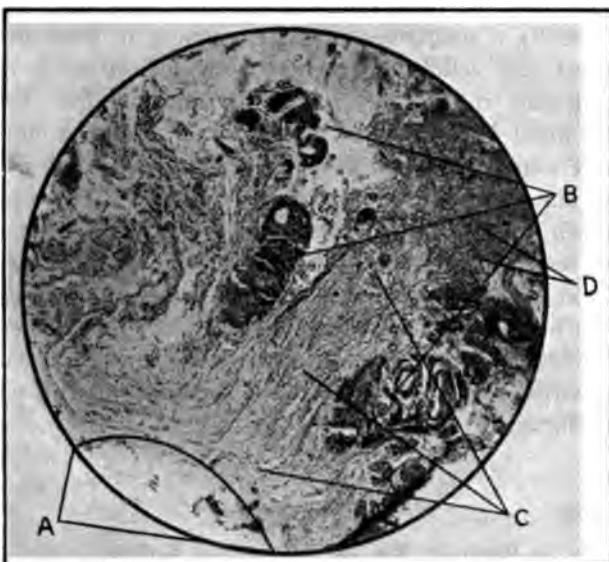


Fig. 59.—Gastric sediment showing fragment of mucosa of the human stomach in a case of advanced, atrophic gastritis. (*Achylia gastrica*.) *A*, muscularis mucosæ at point of rupture; *B*, gastric tubules in various stages of atrophic degeneration; *C*, increase in interglandular connective tissue; *D*, area of congestion.  $\times 100$ . (Lyon.)

rising that, judging from the frequency of the hematemesis and ulceration within the stomach, one so infrequently meets with particles of detached tumor tissue. This is probably because of the greater frequency of cancers of the scirrhouss variety, the relatively smaller size of the softer forms within the organ, and the fact that many of the slower growing types following ulcer are mostly extramural in location. It is quite probable that in many of these, as in sarcoma, only very small particles of the growth are shed, that these are so minute in size and modified by ulceration that they escape detection. For these reasons, I have for years care-

fully examined centrifuged sediments of instillations from a number of cases which, at autopsy, proved the correctness of the diagnosis of malignant disease. On a few occasions I had obtained from these cases tumor particles large enough to section, and from which definite microscopical diagnoses could be made, but in the majority of instances these were not obtainable. In a number of them I observed numerous, free, small round cells which probably were from the malignant growth, but I was never able to satisfy myself that those I saw were always from the growth itself and not free nuclei from innocent cellular elements or very small cells from the vegetable substances of foods. When one has a case in which clinically a diagnosis of gastric cancer is most probable, the examination of the cellular elements from the stomach often gives encouraging results in the way of noting cancer cells. But in these instances the mind is already biased in favor of the findings, and an unwarrantable extent of diagnostic deduction from what is seen takes place. It is quite a different matter to see the same microscopical picture from a stomach where doubt of malignancy exists, or from a case that has not been seen by the one who makes the microscopical examination, and say, "That cell is from a cancer; this is vegetable substance; and those are free nuclei from squamous cells, leucocytes, pus cells, etc." I doubt that cancer cells can be definitely distinguished as such, unless some tissue stroma is with them so as to make up the pathological picture of malignant tissue.

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## CHAPTER VIII.

### Significance and Methods of Examination of Feces in Gastric Diseases.

As our knowledge of digestive diseases advances, the examination of feces occupies a constantly enlarging significant rôle in diagnosis. Considering that the stomach is only one section of the digestive tract, and that a digestive disorder in this organ may be compensated for in the intestines, in so far as the direct diagnoses of most gastric diseases are concerned, the examination of the feces possesses only a minor or primary value—excepting the tests for blood due to gastric hemorrhage. But in the diagnosis of intestinal conditions, either primary or such as may occur secondarily from digestive error in the stomach and upper part of the small intestine and cause symptoms referred to the stomach, the feces examinations are of much importance. Of late, a more or less correct tendency has developed in the consideration of digestive disorders by attaching a minor importance to detailed examinations, and diagnosing digestive errors by the ingestion of certain foods in known quantities and examining the feces to note the general status of its digestion and resorption in the gastro-enteric canal as a whole. While such is of vast service in the regulation of diets—even in what may be considered as only gastric cases—and in the diagnosis of gastro-enteric atrophy and distinct bowel conditions, it has its limitations when we try to localize disease, and also diagnose the various conditions found only in the stomach or the small or large intestine. Personally, I believe that the long-established custom of gastric analysis and feces examinations should be retained, to which as a third means of diagnostic and therapeutic procedure what may be termed "the food-feces method" should be added. The analysis of a stomach content indicates most definitely the digestive ability or presence of disease in the alimentary canal at and above the pylorus, whereas the examination of feces embraces the dual diagnostic and functional importance of both the stomach and intestines, and for this reason the examination of the feces will be dealt with in some detail.

The feces is made up of a mixture of indigestible and undigested particles of food, the unabsorbed secretions of the gastro-intestinal tract, and their decomposition products, together with intestinal mucus,

teria, etc., which are mostly added to it below the pylorus. In addition to the examinations for these, the information obtained by *red-eye* inspection of the stools relates to their odor, reaction, shape, consistency, color, and observance of particles of food.

The number of stools which persons pass in twenty-four hours under similar and normal conditions is more or less constant. In the infant about four, in the child about two, and in the adult one passage a day may be taken as desirable standards, although in adults two passages a day, or the bowels moving only every second day, are not extreme unphysiological departures. Adults whose bowels move less frequently than once every two days, or only when energized by laxative or purgative agencies, may be considered as constipated. Among the gastro-intestinal conditions in which constipation is particularly noted are: alterations in the quantity or quality of the digestive fluids; deficiency of bile secretion (although when stenotic conditions of the bowel passages are present for some days the resulting increased putrefaction and irritation of foods in the intestines may cause a looseness of the bowels); in esophageal and pyloric stenosis because of the small amounts of foods which pass into the intestines; in ptosis of the abdominal organs, and myasthenic or atonic conditions of the gastrointestinal or abdominal walls; in deficiency of the motor power of the intestines, either because of local atonic or atrophic disease, or secondary to low constitutional states; in hernia, contracted (spasmodic), organic, or malignant strictures of the small and large intestine and rectum; in sigmoid paresis from local causes or reflexly from disturbances of the internal generative organs in the female; and for dietary reasons, such as deficient ingestion of water, too little vegetable substances, or a high albumin or milk diet.

In diarrhea, the consistency of the stool is materially diminished, the number of daily movements is increased. Among the gastro-intestinal conditions in which the latter are noted are the following: acute gastritis and enterocolitis; acute exacerbations of the low secretory chronic myasthenic gastritis (where, because of fermentation of gases in the stomach, or acute extension of the catarrhal process into the duodenum, the foods act as intestinal irritants); the infectious diseases of the intestines (acute enteritis, Asiatic cholera, cholera infantum, typhoid, etc.); ulcerative or malignant disease of the lower bowel or rectum; and the acute poisonings (arsenical, non-edible mushroom, etc.).

The amount of feces evacuated in twenty-four hours is of some significance in the diagnosis of digestive disorders. Leaving out of consideration the small fecal output in stenotic conditions of the alimentary canal, the dry, condensed, scybalaous movements in habitual

constipation, and those conditions where from excessive admixture with water the weight of the excreta is increased, the excretion of unusually large amounts of feces may be observed: in constipation when, after a collection, much feces is evacuated during a short time following the release of an obstruction, particularly in the lower colon or rectum; in biliary obstruction, where, from lack of sufficient digestive flow of bile much food fails of absorption because of incomplete digestion; in enteritis, where because of the lack of the proper digestive secretory and motor functions low food conversion is met with; and lastly, in fermentative or putrefactive irritative conditions of the gastro-intestinal canal (the colon particularly), where inhibition of resorption or perversion of proper food conversion exists. The extreme limits in health may be regarded as 60 to 270 grams, the quantity being small in proteid diets, and large in heavy eaters and in those who partake largely of vegetable or starchy foods. Over 500 grams are usually pathological. Schmidt reported a case of enteritis in which the output in three days was 2780 grams, and even larger figures have been reported—mainly in constipation. My experience has been that in a normal adult of average build whose bowels move daily, the normal output should be about one gram of feces to each pound of body weight. This, of course, is subject to variation according to the amount and character of foods taken, and the amount of adipose tissue in the body make-up of the individual.

As was stated before, the consistency of a stool depends upon the amount of water present, and this is high in purely vegetable diets (80 per cent.), and low with proteid foods (60 per cent.). A stool formed from a mixed diet is about 75 per cent. water. In appearance, a normal stool may be considered as being in the first part cylindrical-shaped, and in the last part a rather firm mush. A stool made up of many small-sized, marble-shaped masses (scybala) is commonly observed in constipation from any cause. Ribbon-shaped or pencil-sized stools are seen in enterospasm from neuroses, irritative spasms from digestive causes, or organic strictures of the colon.

The odor and reaction of stools are of some value in diagnosis. The odor of a fresh normal stool is not particularly unpleasant, or it may have but a very slight odor. When to the normally present aromatic substances (indol and skatol) much sulphurated hydrogen methane and phosphine are added, a disagreeable odor is produced—such stools are seen in jaundiced or other conditions in which there is a deficiency of bile in the intestine (acholic stools), in acute gastritis or enteritis and gastro-enteritis, the intestinal putrefactions, and occasionally in constipation, etc. An unusually offensive stool is me

with in ulcerative (syphilitic), malignant (cancer), or infectious (gangrenous dysentery) conditions, and in disease of the lower bowel or rectum. An ammoniacal odor is due to a mixing with urine which is undergoing decomposition.

The commonest reaction of normal feces is neutral, sometimes it is alkaline, but rarely acid. The alkalinity is probably due to ammoniacal putrefaction, and when an acidity exists it is usually due to lactic and butyric acid production from excessive fermentative or putrefactive changes in the lower bowel. At times, particularly in diarrhea, the feces may be strongly alkaline, a condition also rather commonly present in fermentative conditions. As there is still much doubt about the reaction of the feces as pertaining to the organisms concerned, too much clinical significance cannot be attached to these examinations. The practical deductions to-day may be considered by recollecting that digestion in the small intestine is alkaline or neutral, and that when acidity of stools exists such must have been caused by organisms in the lower bowel, and that should the food contents have been hurried through, a distinct alkalinity may be present. Still, a higher acidity than what may be considered as normal cannot be looked upon as positive evidence of putrefactive conditions, since the alkaline producing micro-organisms may be concerned in modifying or changing it to an alkalinity.

The color of stools has some diagnostic importance. Ordinarily the color is modified by the character of foods that have been ingested. In exclusive milk diets the stools are a light yellow; starches may also lighten the color. Red fruits may give them a reddish tinge, and vegetables with much chlorophyll may produce a greenish hue. Huckleberries and red wine produce a blackish color; chocolate and cocoa, a gray; and preparations of iron, manganese, bismuth, and cerium, a dark brown, black, or greenish gray. Calomel usually produces stools colored green with biliverdin; santonin, rhubarb and senna, a yellow color; and ipecacuanha a very light color, almost an acholic stool. Hard stools are usually dark in color, pasty stools a brown, and diarrheal movements considerably lighter. The surface of feces exposed to the air darkens from oxidation.

In the pathological conditions in which change in the color of the stools is observed are, firstly, the clay-colored stool which is characteristic of a deficient amount of bile coloring matter in the intestine from stenosis in or about the gall-bladder or ducts, or deficiency of hepatic function in the manufacturing of bile. Such stools are usually soft and pasty, and sometimes even white in color. Strümpell has stated that such stools are not so much due to deficiency of

bile coloring matter as to the insufficient absorption of fats which occurs in these conditions. The factor in favor of this contention is that such acholic stools may occur in leukemia, chronic nephritis, chlorosis, tuberculosis of the intestine and peritoneum, etc., and still the gall passages be patent. On the other hand, are the facts that in these conditions bile may not be excreted into the intestine in the normal way, that bilirubin may undergo decomposition into colorless products (leuco-urobilin of Nencki), the fact that all such acholic stools are not high or contain increased amounts of fats, and the close association of pathological findings about the biliary area in most of the cases in which acholic stools were steadily present. An admixture of large amounts of pus may also cause a light-colored stool (dysentery, perforation of pelvic abscess into the rectum, syphilic and carcinomatous ulceration of the colon and rectum).

The second type of stool is the one produced by mixture with blood; it may be colored a scarlet-red, a dirty brownish-red, a coffee-ground, or a black, depending upon the source of the hemorrhage, the length of stay in the bowel, the amount of blood and the condition of mixture. Blood from low in the colon or rectum is observed bright in color and usually found on the surface of the feces (adherent blood) and not in the interior of the stool when this is of some firmness. Such is commonly observed in hemorrhoids, malignant, ulcerated and inflammatory diseases of the colon and rectum.

An intimate mixture with blood is the kind of stool that most concerns us in the diagnosis of gastric conditions. In these instances, the blood is so altered by the digestive fluids in the stomach and small intestine that it assumes a black or brownish-black appearance or may resemble coffee grounds (the dark color is due to the formation of ferruginous sulphide). On the other hand, irritative conditions of the stomach and small intestine with bleeding may exist in which the contents are passed along so rapidly that the blood appears in the stool quite bright. However, when the stools are of some firmness and the hemorrhage of large extent, such blood will be found to be intimately incorporated with the feces as well as free on the surface. The important point to note is whether the blood is found only on the surface or outer layer of the feces, as is seen in colon and rectum bleeding, is it only found there, or is it also intimately incorporated with the feces, as is observed when the bleeding comes from a higher source (such as ulcer or malignant disease of the stomach and small intestine, ruptured esophageal or gastric varix, and the swallowed variety from the nose or lungs). Such stools are usually quite readily recognized with the naked eye, or by the examination of a loop or two from the interior of the feces.

with the microscope. Often, conditions in which blood may macroscopically be observed are strangulated hernia, intussusception, severe gastritis and enteritis, amyloid disease of the intestine; corrosive poisons, especially arsenic and phosphorus, rupture of an aneurism of the abdominal aorta into the digestive canal; aneurism or thrombosis of the superior mesenteric artery, from congestive stasis and hemorrhage produced by obstruction of the portal circulation (cancer or cirrhosis of the liver, valvular disease of the heart, portal thrombosis, Banti's disease, pulmonary emphysema); in the infectious diseases (yellow fever, pernicious malaria, acute yellow atrophy of the liver, typhoid, septicemia, pyemia); in the blood disorders (leukemia, hemophilia, purpura haemorrhagica, scurvy); in injuries to the bowel, and in intestinal parasites.

Of particular interest is the presence of blood as a diagnostic symptom in ulcer or cancer of the stomach and small intestine, hemorrhagic pancreatitis, and catarrhal jaundice. In these, the blood may be so small in amount, or be so changed in character, that its presence may not be noted with the naked eye (occult blood). Such stools are of great diagnostic significance in digestive disorders, and the condition would be overlooked unless chemical tests for the presence of blood were performed. In fact, I may say, that in gastric and duodenal ulcers, in all of the acute, partially healed, or chronic forms, and in malignant disease (both primary cancer and sarcoma of the stomach) this objective symptom is of first importance in the diagnosis. It is surprising how constantly blood is found present in the feces in most of the cases in the above mentioned conditions. This, however, excepts many of the cases of extra gastric cancer (ulcus carcinomatous), and some of the cases of scirrhouss gastric carcinomata where these are very hard and non-ulcerated. When performed under proper conditions, a positive blood-reaction of feces—even when slight—should never be overlooked upon lightly or discarded without an exhaustive examination. Particularly is this true when such findings are rather constantly present. As time goes on I am attaching more and more importance to the value of these tests in the early diagnosis of malignant gastric disease, since such are often observed long before tumors are palpable, and characteristic chemical and dynamic changes, or the common objective or subjective symptoms develop. In ulcers the blood is usually intermittently present, varying all the way from coffee-ground stools from large amounts of blood, to stools in which blood is not recognized (excepting by the chemical tests), and stools which at one time are blood-free, and at another time contain blood. In cancer the chemical tests are more regularly positive, although macroscopic-

ally blood is rarely observed—sometimes not even at the fatal issue of the case. This also holds true in sarcoma in which the loss of the gastric secretions and motor function of the stomach, palpable tumor, and other symptoms of note in malignant disease may be absent altogether; in which case the gastric functions of the stomach are too slightly modified for definite diagnostic purposes. Excepting in some cases of cancer of the gall-bladder and the other conditions of the biliary passages in which blood-stools may be observed, it usually manifests its presence for only a short time. Other sources of bleeding must, of course, be excluded, and that from meats and fish in the diet also—this cannot be done unless these articles of food have not been taken for at least forty-eight hours before the passage of the examined stool, assuming that the bowels are moving freely.

The technique of examination for blood is about as follows: For adherent blood, a scraping of feces from the surface is mixed with a drop of water on a slide. This may be dried, fixed and stained in the usual way for blood, or a cover glass is put upon the wet specimen and examined directly for the presence of red blood-cells or hematoidin, which appear as brownish-red masses. The incorporated blood is examined for in the same way; only a portion of the interior is taken. As a rule unless the bleeding had been large in amount and the blood fresh (when it would be noticed macroscopically by its color), these examinations are not satisfactory and must be followed by the chemical tests described in the foregoing chapter. Of these, in my experience, the tests arranged in the order of their practical value for feces are the aloin, benzidine, guaiac, and hemin. For the color tests, about 5 grams of the softest portion of the feces are mixed with from 5 to 10 cubic centimeters of water, and separated with glacial acetic acid and ether in the usual way as for gastric contents.

Boas describes a modification of his recently proposed method of performing the phenolphthalein test for occult blood in the feces. The reagent is prepared as follows: 25 grams of potassium hydrate are dissolved in 100 cubic centimeters of distilled water; 1 gram of phenolphthalein is added, and the mixture is shaken vigorously. After solution is complete, powdered metallic zinc is added, and the preparation is boiled in an Erlenmeyer flask until the fluid is completely decolorized. After cooling, distilled water is added to the original volume and the solution is filtered. The filtrate is water-clear and remains colorless when acetic acid, alcohol and hydrogen peroxide are added to a portion of it in a test-tube. The solution is stable for several weeks. In the course of time oxidation of the phenolphthalein around the lip of the bottle may occur. It is always advisable to use a colorless solution.

\* Boas describes as follows: An acid and 15-20 cubic centimetre dropping bottle 15 drops added 5-6 drops of absolute alcohol. And the filtrate is a layer with the employed. If blood or gradually a rose color depending upon color is faint, it is more white background.

But when such is the case, add humm for increasing the dibbed up with equal parts of When the filtrate is evaporated added in acetic acid-alcohol and the fecal extract, the method as rose-colored ring becomes definite but duplicate tests with guaiac and phenolphthalein test more delicate than positive than the guaiac. Furthermore, and benzidin tests positive, the phenolphthalein plainly positive. The observations occult blood in the feces.

Used instead but of more value is the benzidin which consists in adding a few drops of powdered benzidin (an amount the size of a millimeters of glacial acetic acid, and 20 drops of hydrogen peroxide to a little solid feces on a venish-blue fading color is positive. The material of this test may now be obtained in very convenient physician.

Give experience with this test, Dr. Vaughan concludes it reliable, as well as the most simple, rapid, and clean. Links, too delicate for clinical use. A negative result is evidence of the absence of blood than a negative guaiac fibers, pus, and the usual drugs and food do not vitiate this meat does so only if it has been taken in considerable

other findings which have a practical value in diagnosing conditions of the digestive canal, particularly the intestines, and which

layer of turpentine to diminish the disagreeable odor (the use of a small portion of specimen covered by a cover glass usually suffices).

Meat fibers are usually observed in every stool whenever meat has been eaten. Under normal conditions they are not many (excepting in heavy meat eaters), but in atrophic conditions of the gastroenteric tract and disease of the pancreas they are very numerous. In these states a clinical importance can be attached to the number and character of the fibers seen (since they persist usually many, often twenty-four or thirty-six hours, after the mixed meal, and the more or

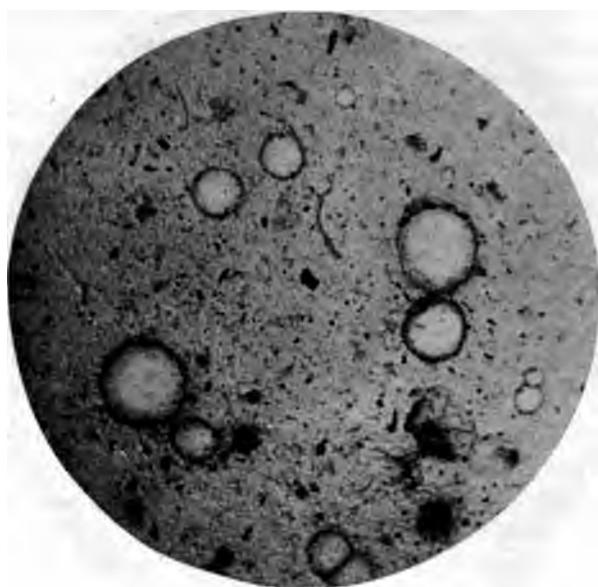


Fig. 62.—Photomicrograph of a drop of feces from a case of chronic enteritis (small intestine) showing the accompanying steatorrhea. The round, whitish, glistening masses represent the fat; the other particles, undigested foods and detritus of feces.  $\times 320$ .

normal loss or separation of the transverse striations are not observed. In the process of normal digestion, the meat fibers are separated from one another, and then a separation of the disks at the transverse striation occurs. In atrophic conditions when the digestive secretions are scanty or absent, or when through irritation the food is hurried through the canal, the fibers observed are all about the same size and shape (cylinders with parallel sides), with the characteristic cross lines between the non-separated disks sharply defined.

Isolated starch granules are not often observed in the feces of an adult, and are not of much clinical significance when they are. The

Presence is easily recognized by treating the specimen with a drop of Lugol's solution when the granules or fragments become blue or a mahogany-red according to the stage of conversion. The indigestible cellulose framework or skins of vegetable substances are commonly observed but are of no practical significance.

The presence of fat in feces is quite constant in normal stools. The common form in which it is observed is that of the needle crystals of fatty acids (which are readily transformed into fat drops by the addition of sulphuric acid and heat), although the highly refractile



Fig. 63.—Photomicrograph of a drop of feces from a case of chronic catarrhal enteritis showing crystals of neutral calcium phosphate.  $\times 70$ .

fat droplets may be observed in the first instance. In the acholic stools, from whatever cause, the fat proportion is immensely increased so that crystals and droplets will mostly comprise the field. This is an important fact, because a light stool may be observed when bile was being discharged into the intestine (leuco-urobilin formed), and thus an acholic stool should not be diagnosed unless the excess fat picture is microscopically observed. Another reason why the fat examinations should be made is because extensive disease of the pancreas may exist without seriously affecting the amylolytic digestion.

Other crystals that are also commonly observed are the calcium and magnesium salts, and cholesterin. Of the first two, the kinds

ordinarily seen are neutral calcium phosphate, calcium oxalate, calcium sulphate, and ammoniomagnesium phosphate. They possess no special significance unless present in large numbers.

The calcium and magnesium crystals are commonly increased in errors of digestion. In the chronic catarrhal conditions, particularly of the small intestine, they possess a diagnostic significance when numerously present. The neutral phosphates are not stained by bile pigment, and the triple phosphate in rare instances only. Both are soluble in acetic acid. The calcium oxalate crystals are observed in

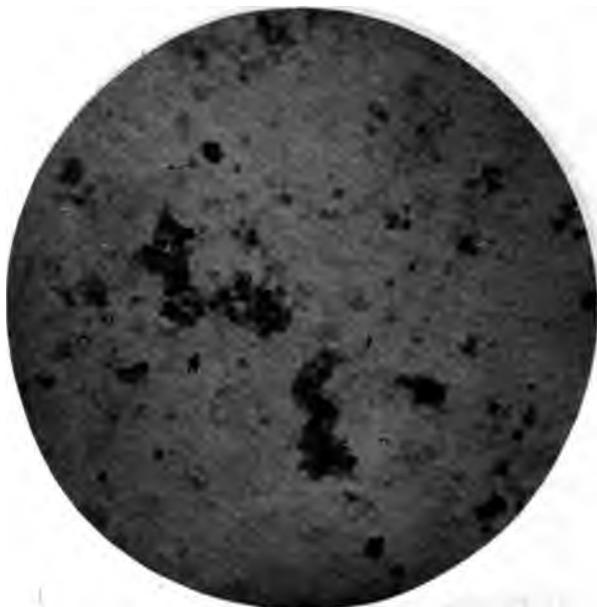


Fig. 64.—Photomicrograph of feces which had stood for two days showing mostly crystals of ammoniomagnesium phosphate.  $\times 70$ .

high vegetable diets, and when a low state of conversion of carbohydrates is present in the digestive canal. These crystals are generally imbedded in vegetable substance, and are usually bile-stained, and are insoluble in acetic acid. Calcium lactate crystals are common in milk diets of both the infant and adult. They, with calcium sulphate, are of no significance. Cholesterin, while normally present in feces, is rarely observed in crystal form. Hematoidin crystals may be seen where blood is present, and the Charcot-Leyden crystals may be found in typhoid, dysentery, and phthisis.

The significance of and examination for blood, pus, tissue, and sloughs, have already been described. Particles of tissue are difficult

to obtain from feces unless they are passed separately or in very fluid stools. When obtained they should be hardened, cut, stained, and examined in the usual way.

Small particles of mucus are observed only by the microscope. They are commonly met with in catarrhal, infectious, ulcerative, and malignant conditions of the digestive tract, and possess a diagnostic significance. When in small particles, incorporated with the feces, and bile stained, they are indicative of disease of the small intestine.

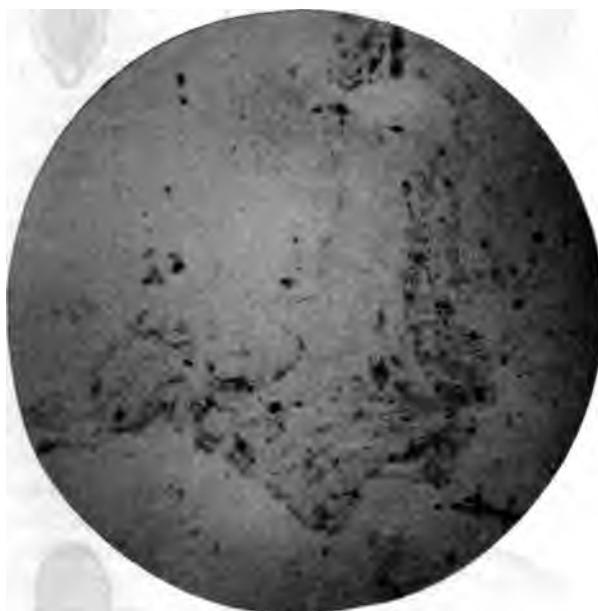


Fig. 65.—Photomicrograph of a portion of the same mucus as is shown in Fig. 60. Note that its structure is simply that of mucus and is not fibrous in nature as its appearance would suggest. The dark spots represent adherent particles of feces.  $\times 70$ .

When from the region of the ileocecal valve, the mucus is observed in larger particles and colorless or only partly bile stained. In colonic conditions (colitis, coloptosis, constipation), the mucus may be passed as long fibrous-looking masses, which, under the microscope, display characteristic mucous structure with more or less fecal detritus adherent to them. In case such patients are constipated, as they usually are, the mucus may be stained yellow from its long stay in the colon, and often is passed in large quantities with the stool. At other times, such mucus may not be noticed macroscopically unless the fresh stool is examined in water, when the ends of the shaggy mucous formation will

be seen to be floating off from the feces (if the stool is soft this may not be observed). Mucus derived from the sigmoid and rectum is usually of the clear, viscid fluid variety, and a more or less steady loss of this may occur at intervals between stools, some patients passing as much as 30 cubic centimeters or more of such mucus at one time. Fluid

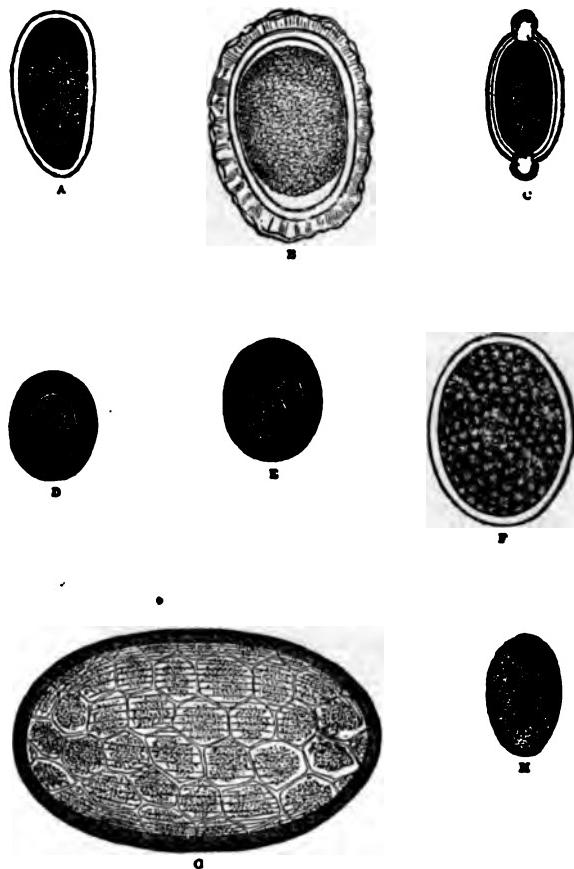


Fig. 66.—Ova of entozoa,  $\times 350$  (after Heller). *A*, *Oxyuris vermicularis*. *B*, *Ascaris lumbricoides*. *C*, *Trichocephalus dispar*. *D*, *Tænia solium*. *E*, *Tænia saginata*. *F*, *Bothriocephalus latus*. *G*, *Distoma hepaticum*. *H*, *Distoma lanceolatum*.

mucous stools are commonly observed in sigmoiditis, proctitis, marked membranous colitis with catarrhal extension low in the large bowel and rectum, and in beginning ulcerative, infectious or malignant conditions in these locations (in the latter more or less pus and blood are present in the mucus).

with the microscope. Often, conditions in which blood may macroscopically be observed are strangulated hernia, intussusception, severe gastritis and enteritis, amyloid disease of the intestine; corrosive poisons, especially arsenic and phosphorus, rupture of an aneurism of the abdominal aorta into the digestive canal; aneurism or thrombosis of the superior mesenteric artery, from congestive stasis and hemorrhage produced by obstruction of the portal circulation (cancer or cirrhosis of the liver, valvular disease of the heart, portal thrombosis, Banti's disease, pulmonary emphysema); in the infectious diseases (yellow fever, pernicious malaria, acute yellow atrophy of the liver, typhoid, septicemia, pyemia); in the blood disorders (leukemia, hemophilia, purpura haemorrhagica, scurvy); in injuries to the bowel, and in intestinal parasites.

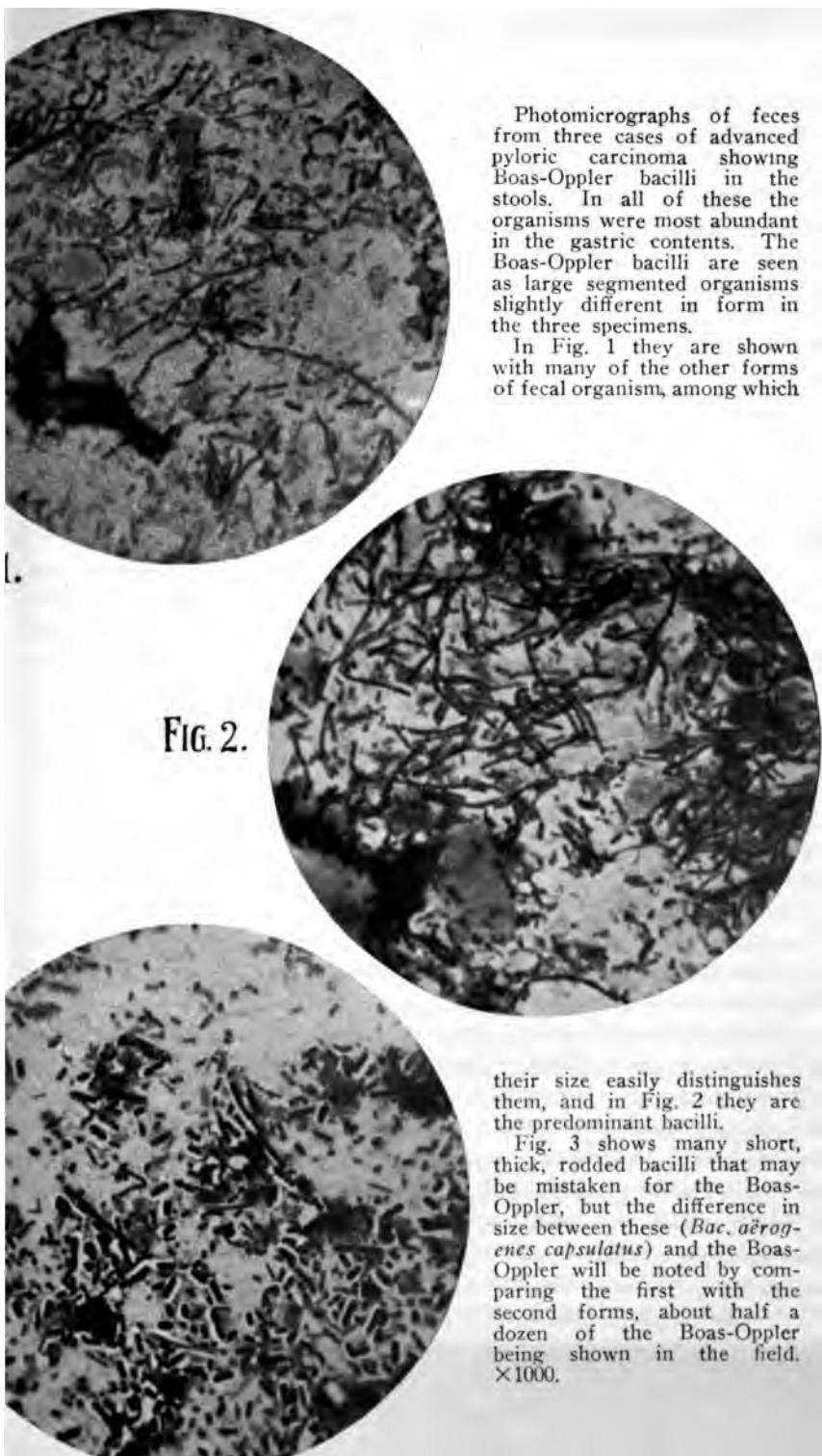
Of particular interest is the presence of blood as a diagnostic symptom in ulcer or cancer of the stomach and small intestine, hemorrhagic pancreatitis, and catarrhal jaundice. In these, the blood may be so small in amount, or be so changed in character, that its presence may not be noted with the naked eye (occult blood). Such stools are of great diagnostic significance in digestive disorders, and the condition would be overlooked unless chemical tests for the presence of blood were performed. In fact, I may say, that in gastric and duodenal ulcers, in all of the acute, partially healed, or chronic forms, and in malignant disease (both primary cancer and sarcoma of the stomach) this objective symptom is of first importance in the diagnosis. It is surprising how constantly blood is found present in the feces in most of the cases in the above mentioned conditions. This, however, excepts many of the cases of extra gastric cancer (*ulcus carcinomatous*), and some of the cases of scirrhouss gastric carcinomata where these are very hard and non-ulcerated. When performed under proper conditions, a positive blood-reaction of feces—even when slight—should never be looked upon lightly or discarded without an exhaustive examination. Particularly is this true when such findings are rather constantly present. As time goes on I am attaching more and more importance to the value of these tests in the early diagnosis of malignant gastric disease, since such are often observed long before tumors are palpable, and characteristic chemical and dynamic changes, or the common objective or subjective symptoms develop. In ulcers the blood is usually intermittently present, varying all the way from coffee-ground stools from large amounts of blood, to stools in which blood is not recognized (excepting by the chemical tests), and stools which at one time are blood-free, and at another time contain blood. In cancer the chemical tests are more regularly positive, although macroscopic-

material are thoroughly mixed with 5 cubic centimeters of a 2 per cent aqueous solution of compound solution of cresol in a centrifuge tube. The specimens are centrifugalized at high speed for one minute, the supernatant liquid is then decanted and fresh compound cresol solution added and mixed with the sediment in the tubes. This operation is repeated three times. On completion of the centrifugalization process a small portion of the bottom sediment is removed with a clean pipette and placed on a clean slide, a small drop of anilin gentian violet mixed with the sediment, and a clean cover-glass placed on it.

If the adult worms (vermes) are not recognized in the feces, the ova from them may be examined for. In the foregoing illustration (Fig. 66) the common forms of ova are shown with sufficient distinctness for identification. Matter pertaining to the less common forms of animal parasites, such as those reported from the East, Greenland, etc., can be found in works on animal parasitology.

As stated by myself several years ago, the Boas-Oppler bacilli from the stagnant stomach of pyloric carcinoma may be found in the feces and often in great numbers. The fecal bacteria in normal stools are noted in a variety of forms and sizes. Some of these, among which are the fungi, are large in size and may be mistaken for the Boas-Oppler. In distinguishing the latter from the long, thick-rodded, less important forms, it is essential to remember that the Boas-Oppler are longer than any bacteria commonly seen, and in pyloric cancer they may be the predominant organism, in which case they are always easily observed because of their great numbers. In an individual who gives a suggestive history, and in whom the clinical symptoms of cancer are present, together with a palpable mass in the epigastrium, the finding of large numbers of Boas-Oppler bacilli in the stool together with the presence of macroscopic or occult blood, the diagnosis of cancer can be made in almost every case. When my suspicions are strong that advanced malignant disease of the stomach exists and if the patient has not been prepared for the extraction of a test-meal at the time, it is my custom to make a slide of the secretions on the back of the tongue and to order the examination of a specimen of stool. When cancer with pyloric obstruction exists, the mouth slide often shows the presence of Boas-Oppler bacilli in the mouth, carried there, no doubt, by the vomitings or regurgitations from the stomach (these must be distinguished from the Leptothrix buccalis, which are also long bodies, a diagnosis that is easy because of the morphological difference between the two and the fact that the Leptothrix stains so distinctly with iodine). The stools, however, usually show the more positive findings, for in the feces the Leptothrix is rarely or never found and the Boas-Oppler bacilli

PLATE LII.



Photomicrographs of feces from three cases of advanced pyloric carcinoma showing Boas-Oppler bacilli in the stools. In all of these the organisms were most abundant in the gastric contents. The Boas-Oppler bacilli are seen as large segmented organisms slightly different in form in the three specimens.

In Fig. 1 they are shown with many of the other forms of fecal organism, among which

their size easily distinguishes them, and in Fig. 2 they are the predominant bacilli.

Fig. 3 shows many short, thick, rodded bacilli that may be mistaken for the Boas-Oppler, but the difference in size between these (*Bac. aerogenes capsulatus*) and the Boas-Oppler will be noted by comparing the first with the second forms, about half a dozen of the Boas-Oppler being shown in the field.  
 $\times 1000$ .

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quite common. In such instances, the examination of the gastric contents for diagnosis is unnecessary.

Without considering the specific organisms found in certain infectious diseases (*Bacillus dysenteriae* Shiga, *Bacillus typhosus* Eberth, tuberculosis Koch), other organisms are found in large numbers in feces. Their numbers have been estimated at one hundred and forty-six billions in the daily human excreta, but of these probably more than from 1 to 5 per cent. are living organisms. This death of bacteria occurs in the lowest portion of the gut, the living organisms being in largest proportion in the vicinity of the ileum and rectal valve. Most of the forms, if not all, had originally been introduced from without in food and drink, and their vast numbers show that they readily proliferate in the digestive canal particularly when the conditions for their doing so are favorable. The most prominent of such conditions is a shortage in the defensive action of the digestive juices (achylic conditions of the stomach, etc.) or a diminution in the antagonism between them (such as a low proportion of the bactericidal coli group); it is probable that the latter is due to the reaction of the fluids of the digestive canal since an alkaline medium is favorable to the putrefactive functions of this group if peptones be present—hence the clinical importance of the reaction of feces.

To no one as much as to C. Herter was due the credit for the study of the bacterial flora in the digestive tract.<sup>1</sup> While this author in his extensive work drew but few practical deductions from his observations, such was mainly because of a rightful conservatism in dealing with the vast and varied subject of the many forms of fecal bacteria encountered, and the fact that laboratory methods of study are different from conditions existing in the intestinal canal; still, some facts have apparently been established which it is hoped will stimulate further effort in this important subject. Several of such which are of radical value are herein contained.

Micro-organisms found in feces are divided into the two broad general groups of the aerobic and anaerobic, the latter being more closely concerned in the putrefactive processes. Of the first, the most notable example is the colon bacillus, which can cause damage in two ways, as an infective agent outside of the digestive tract and as an infective agent inside of the canal. Inside of the canal the bacilli are closely concerned in the production of certain diarrheal conditions, although the dysentery, typhoid, and Shiga bacilli have also been found among them in many of the cases. I studied four cases of ulcerative colitis with chronic diarrhea in which the offending organism was a highly virulent strain of the *B. coli communis*. Considering, however, that the

*B. coli* have been found in large numbers in some acute dyspeptic diarrheal conditions (in which the others above mentioned were not), and that they are often met with in great abundance in excessive carbohydrate fermentations in the intestines, it is possible that an activity of the bacilli of this group in affecting the sugars and liberating irritative organic acids is of practical importance. This seems to be substantiated by the fact that the members of the colon group cannot initiate active putrefaction of the native proteids unless the putrefactive anaerobes, capable of peptonizing proteids, begin the hydrolysis, after which the colon group can become active. Other anaerobes concerned in the production of disorders are the typhoid, dysentery, Shiga, paratyphoid, the liquefying bacteria (of which the *bacillus vulgaris* is well known as capable of producing acute disease of the gastro-enteric tract, and which organism is probably actively concerned in producing indol, skatol, and the amido-acids from proteids), the streptococcal and staphylococcal forms, the *bacillus bifidus*, and others.

There is a fast growing belief that the strict anaerobes play an important part in the pathology of the digestive tract. Of these the *bacillus putrificus* is capable of actively attacking and hydrolyzing native proteids giving rise to the characteristic products of putrefaction, including butyric acid, hydrogen, hydrogen sulphide, and mercaptan, but probably not indol. A brother organism to this one, known as the *paraputrificus*, makes acids from sugars and does not cleave proteids. Herter believed that the *B. putrificus* is the most energetic anaerobe known in respect to ability to proteolyze native proteins, and suggested from a laboratory strain which produced large quantities of indol in peptone bouillon that this organism in the intestine might contribute in an important way to the production of indol. The next anaerobe that has received much attention is the *Bacillus aerogenes capsulatus*, which was first described by Welch, and the virulent form of which has a clinical significance in surgical and obstetrical diseases. This type of organism is a Gram-positive, gas-making bacillus, capable, when injected into animals, of setting up localized necrotic inflammation with gas-production and toxemia. These organisms are large, plump, usually straight bacilli, provided with a capsule, and are often found in the feces in cases of saccharoacetic and the mixed forms of chronic excessive intestinal putrefactions and pernicious anemia in tremendous numbers. The gas they produce is from one-third to one-half carbon dioxide and the remaining mostly hydrogen. When grown on a medium which contains much sugar and but little proteid, large quantities of gas are rapidly generated. In the presence of much proteid, the gas also contains butyric acid. It is probable that

this group of organisms are not active indol producers, but they have a powerful hemolyzing action on the blood, freeing the hemoglobin. The latter action is also noted with the *B. putrificus* but not to such a marked extent. Because of the anaerobic nature of this organism, Herter has employed, to cause their isolation and note their presence, the introducing and growing of this bacteria in the closed circulation of a rabbit. To this end, one or two cubic centimeters of filtered fecal suspension is introduced intravenously into a rabbit and the animal promptly killed by a blow on the neck. The carcass is then incubated for from five to twenty-four hours at 37° C. when an autopsy is performed. When many *B. capsulati* are encountered, the animal will be very foul smelling from butyric decomposition, the abdomen and general carcass much distended with gas which burns with a blue flame, the tissues in a state of putrefactive liquefaction, and the blood, heart, etc., contain bacilli of the encapsulated type, sometimes in almost pure culture.

Herter has pointed out that it is impossible to avoid the entrance of bacteria into the digestive tract, and that the obligate bacteria (for example, *B. lactis aerogenes*, *B. coli*, *B. bifidus*) adapt themselves to the secretions of this part of the digestive tract and hold their own against newcomers. By virtue of their adaptability they ordinarily are not harmful to their host, and under some circumstances they are capable of doing service by giving rise to conditions which discourage the growth of the harmful bacteria that cannot readily be excluded in food and drink. It is most probable that the normal acidity of the gastric juice checks the growth of many non-sporulating bacteria and in a measure is destructive to most varieties. When, on the other hand, the gastric juice or intestinal secretions are scanty or absent, a defective motility exists, or when the bacteria are taken in large amounts (particularly into an empty stomach), there is a chance that some of them will find their way into the intestines. Speaking of the conditions which may be presumed to favor the development of the anaerobes so that large amounts of detrimental products would be absorbed, Herter says, "Especially important are influences which alter the character of the secretions in the large intestine or bring there unusually large quantities of partially digested proteid. In certain conditions of the digestive tract an excessive, or even a moderate, meal of proteid food will precipitate an intoxication or an attack of vomiting or diarrhea. There are cases classed as ptomaine poisoning in which the digestive tract rather than the food is responsible for the observed disorders."

The putrefactive changes are produced largely by the anaërobic bacteria, of which the acidophilic forms grow best on a carbohydrate diet while the protein diet allows the proteolytic organisms to establish themselves and become predominant. These growths are encouraged by such conditions as carious teeth (which appear to be due to action of anaërobes whose growth occurs in the masses of food that lodge between the teeth), stagnant and insufficient HCl secretion, and excessive meat-eating. Herter suggested that the clinical manifestations of intoxications in the different types of poisoning from absorption of the intestinal products are explained by the individual cellular reaction of the patient rather than by the poison. In a half dozen patients suffering from indicanuria, one suffers from headache, sometimes migraine-like; another is prone to lumbago; another perhaps has epileptic seizures; another has mental depression; another progressive muscular atrophy, and another suffers from cyclic vomiting. There is good reason to believe that in one person very similar processes in the digestive tract may lead to digestive disturbances mostly of the subjective kind, and in another, owing to a lesser sensitiveness in the digestive tract itself, to better absorption of the poisons and the development of more remote disorders, such as acute arthritis, anemia, nervous disorders, depressing melancholia, irritability, etc.

Of the chronic excessive putrefactions Herter believes there are three types:—

The indolic type, which seems to be due to members of the ~~Bacillus~~ <sup>E. coli</sup> group, and is characterized clinically by marked indicanuria.

The saccharobutyric type, which seems to be initiated chiefly by the anaërobes, and in the simplest examples of which there is very little indol in the gut and urine.

And a combined type, or cases combining the characteristics of the indolic and saccharobutyric forms.

Since there is so much of clinical interest in these, even in so far as the stomach itself is concerned, both from a local and constitutional viewpoint, it would not be amiss in this connection to consider them for a few moments.

In the indolic type, the members of the *B. coli* group form indol in large quantities and they probably invade the small intestine in large numbers, causing in their activity bacterial cleavages of proteins which largely replace the normal tryptic digestion. In this type of cases, the digestive processes should be improved by proper measures both in so far as the gastric digestion and general health are concerned. The diet should be finely subdivided to insure quick absorption of the digestion products, the milk should be peptonized, and the colon irrigated.

daily to insure the removal of the putrefactive products before they are absorbed.

In the saccharobutyric type of excessive intestinal putrefaction, the putrefactive process is in the large intestine and lower ileum. It is due to the strictly anaerobic butyric acid producing bacteria of which the *B. aërogenes capsulatus* is probably largely responsible, although the *B. putrificus*, the Gram-positive diplococci, and the bacillus of malignant edema may be found. The organisms attack carbohydrates and proteids vigorously and butyric acid is formed from both, at times with propionic, caproic, or valeric acids. These are largely responsible for the giving to the stools their unpleasant odor. The feces in these instances have a very low specific gravity, and often a very light color. From the proteids, besides the above-mentioned acids, hydrogen, carbon dioxide, and perhaps methane are formed. The hydrogen causes the excessive reduction of bilirubin and other pigments—thus the light color. The stools also have an acid reaction, although the acids are partly neutralized by the ammonia and other putrefactive bases formed. The Schmidt test with mercury bichloride gives a strong pink color. Indol is absent or present in small amounts. In the urine, the ethereal sulphates may be present in excess, and mercaptan may be found in the feces, which disappear as the patient improves. The presence of ammonium butyrate may give rise to irritation of the intestine, stomach and mouth. The patients suffer from flatulence made worse by both carbohydrates and acids, which may precipitate a diarrhea. These patients are physically more or less weakened, and have a distinct anemia, which, in grade, may be all the way from a moderate secondary form to serious types approaching that of pernicious anemia.

The combined type in mild forms is the most common. Here there are many putrefactive anaerobes in the gut, and a persistent and well-marked indicanuria which is but slightly influenced by dieting. The nervous symptoms are prominent and appear early; emotional irritability or periods of mental depression and physical or mental activity soon induce fatigue. Later on, blood changes take place, which may finally approach that of pernicious anemia. At times these patients have intervals of improvement, but on the whole the tendency is downward. In well-established instances, a more rapid advance to invalidism is noted than in the single types alone. When the atrophy of fat and muscle tissue and the blood changes are marked, there is commonly present chronic parenchymatous changes in the kidneys and liver as a result of the constant poisonous action.

Lastly, and of the greatest importance in the diagnoses and treatment of stomach conditions, are the effects of these ethereal sulphates

on secretion and motility of the stomach. I have pointed out and firmly maintain that the circulation of large amounts of these toxins has first a stimulating effect in increasing the secretions and motility, and then a depressing effect in decreasing them (the hypersensitive conditions of the stomach remaining always marked). Close study of many of the cases of hyperacidity, hypersecretion, hypo- and anacidity, gastric and enteric atonies and dilatations, and hyperesthesia gastrica, gastralgia, enteralgia, etc., proves that these are very often symptomatic states resulting from the intestinal condition and not primary conditions of the stomach itself. Unless this is constantly kept in mind, only incomplete and transitory results from therapy can come in many of the cases, especially when the stomach alone is considered from the therapeutic standpoint.

As was mentioned before, the larger proportion of bacteria die in their passage through the colon, and thus only a small number can be cultivated from the stool. Moreover, the different portions of a stool have different quantities of bacteria. For these reasons Strasburger has devised a means of determining the actual dried weight of all the bacteria whether living or dead. It must be remembered, however, that in this examination of the feces no distinction is made between the putrefactive and fermentative bacteria, and which form predominates must be ascertained by other means (cultivation, aldehyde reaction, litmus).

The diet is the most important factor in influencing the bacterial growth in the intestine. Foods that are digested and absorbed early in their passage through the gastro-intestinal canal leave but little residue for the bacteria to live upon, and consequently in such instances the bacterial count will be low. When the reverse is the case (foods difficult to digest, or when secretory disturbances of a depressing character exist not allowing normal conversion), the bacterial count will be high. Observations on full home diets give from 18.1 to 20.5 per cent. bacteria; full hospital diet from 18.2 to 21.1 per cent. bacteria; semiliquid hospital diet 15.6 per cent. bacteria; and milk diet gave 13.2 per cent. bacteria. These figures suggest the importance of dieting as a remedy for excessive bacterial growth in the intestines.

According to Strasburger, one-quarter to one-third of the dried weight of feces represents bacteria (these figures of course are modified according to the character and amounts of foods present in the intestine). As an average, one-quarter would probably be nearer correct for the ordinary individual, since many stools from normal persons contain less than this.

PLATE LIII.



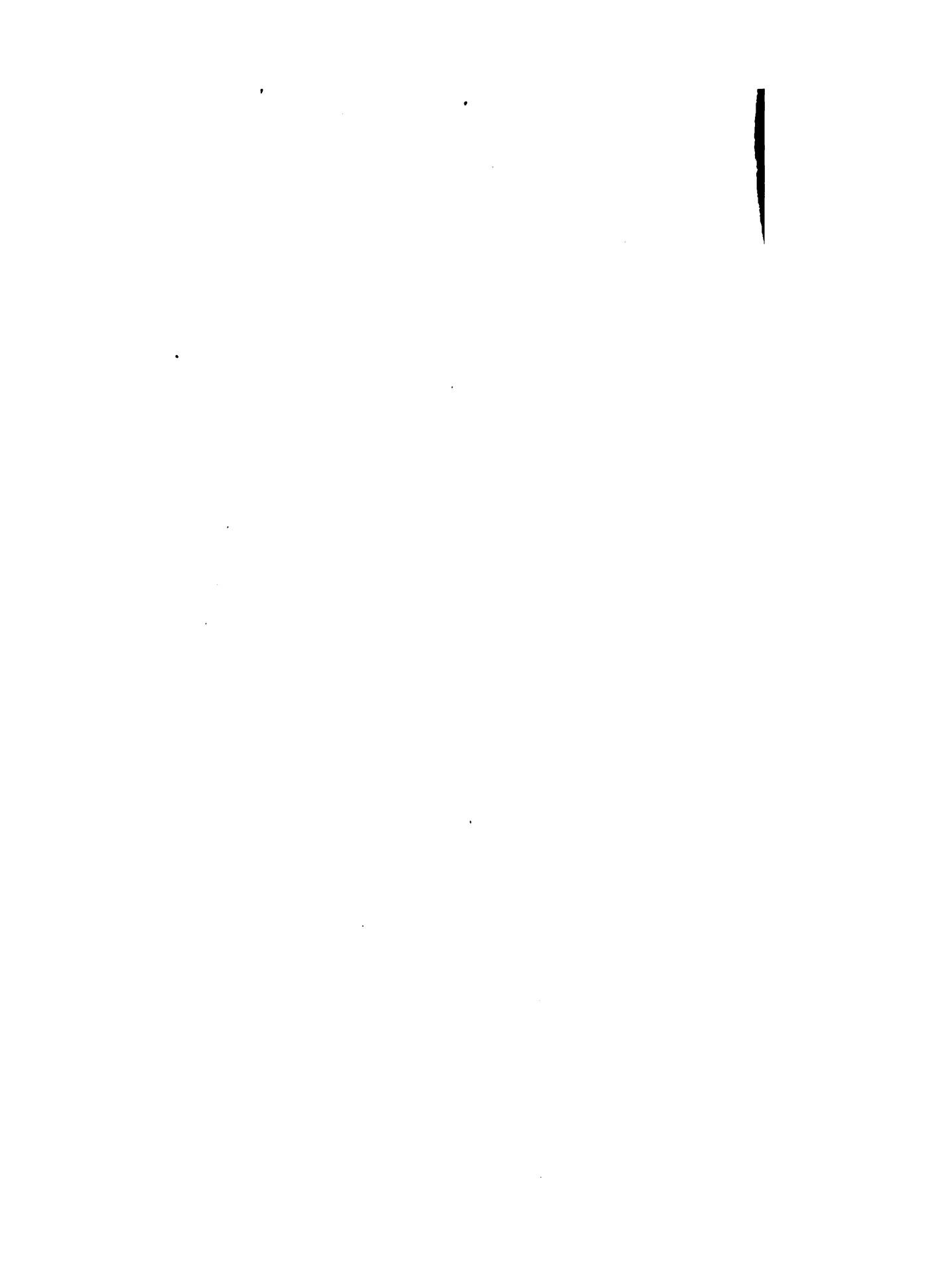
A drop of feces and water from a case of gastro-enteric atrophy, in which there was an absence of gastric juice secretion, a high albumin loss in digestion, a marked indicanuria in the urine, and an excess putrefaction in the colon.  
Stained by the Gram method.  $\times 1000$ .

on secretion and motility of the stomach. I have pointed out firmly maintain that the circulation of large amounts of these has first a stimulating effect in increasing the secretions and and then a depressing effect in decreasing them (the hypersecretion conditions of the stomach remaining always marked). Close study many of the cases of hyperacidity, hypersecretion, hypo- and anaesthesia gastric and enteric atony and dilatations, and hyperesthesia gastralgia, enteralgia, etc., proves that these are very often symptomatic states resulting from the intestinal condition and not primary conditions of the stomach itself. Unless this is constantly kept in mind incomplete and transitory results from therapy can come in many cases, especially when the stomach alone is considered from the therapeutic standpoint.

As was mentioned before, the larger proportion of bacteria in their passage through the colon, and thus only a small number can be cultivated from the stool. Moreover, the different portions of stool have different quantities of bacteria. For these reasons Strasburger has devised a means of determining the actual dried weight of all the bacteria whether living or dead. It must be remembered however, that in this examination of the feces no distinction is made between the putrefactive and fermentative bacteria, and which predominates must be ascertained by other means (cultivation, alkali reaction, litmus).

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According to Strasburger, one-quarter to one-third of the weight of feces represents bacteria (these figures of course are determined according to the character and amounts of foods present in the intestine). As an average, one-quarter would probably be nearer the truth for the ordinary individual, since many stools from normal persons contain less than this.



The bacteria are found in increased amounts in achylia, in exacerbative and putrefactive conditions in the gut, in poor starch diet from any cause, in chronic cholecystitis, disease of the pancreas, and large mixed diets, particularly when containing vegetables and fruit, etc. The bacteria are usually found decreased in amounts in habitual constipation of the atrophic and atonic types, when the foods are small in amounts or only fluid or semifluid in character, and for stenotic reasons at the pylorus, in the esophagus or in the intestine, but little food can be taken or would pass into the lower

The technique of the method of examination, which was so well described by Steele,<sup>2</sup> is the following:—

The possibility of separating the bacteria from the rest of the feces depends upon the fact that the bacteria are so nearly of the same specific gravity as distilled water that they cannot be centrifugated from a watery suspension of the feces, but remain suspended in supernatant fluid. Taking advantage of this, the bacteria can be separated by washing with the centrifuge. Then if the specific gravity of the wash water is lowered by the addition of large amounts of alcohol, the weight relation of the bacteria to the fluid is changed to such an extent that the micro-organisms can readily be centrifugated, separated, dried, and weighed.

Unless the period of passage of the feces has been ascertained to be normal, it is better to mark the beginning and end of each period of elimination by carmine. The use of the Schmidt diet is not necessary.

Indeed, I have found that this diet is not desirable because it leaves very little residue, and so of itself reduces the total amount of bacteria to a lower point than that which is usually found.

The whole stool is saved. Unless the feces are liquid they are washed up with a known amount of distilled water until they are thin and semiliquid and as homogeneous as it is possible to make.

This is a modification of my own, intended to make it easier to obtain a specimen of the stool that is fairly indicative of the average amount of bacteria contained in each cubic centimeter. Strasburger takes but 2 cubic centimeters of the formed feces. It seems to me that the different portions of the stool differ so in consistency and position, this method of Strasburger leads to considerable error. I believe that my modification insures a much more accurate idea of the average consistency of the stool.

Two portions of 5 cubic centimeters are measured off with a glass tube of large caliber. I use for this purpose an ordinary 5 cubic centimeter pipette with the tapering end cut off, and with the neces-

sary correction made at the mark. One of these portions of 5 cubic centimeters is put into a porcelain dish and dried upon a water bath and later in a drying-oven, in order to determine the dried weight. The addition of a little alcohol and thorough mixing will hasten the process of drying and prevent caking of the feces. The second portion is washed free from bacteria. This is done as follows: The wash water is 0.5 per cent. HCl solution in distilled water. The acid increases the solubility of the salts and soaps of the feces. I usually employ about 100 cubic centimeters of this solution at the beginning of the washing. The feces are thoroughly mixed with the wash solution and then centrifugated. The use of the water motor or electric centrifuge is almost essential. Each tube is centrifugated for about one and a half minutes; then the cloudy, supernatant liquid is poured through a layer of gauze. This fluid contains the bacteria in suspension. All of the mixture (the wash water and the feces) is centrifugated in the same way, and then the residue in the tubes is shaken up with more of the wash water, and centrifugated again. This is repeated until the supernatant liquid after centrifugating is quite transparent, showing that approximately all of the bacteria have been washed out. If a smear is made of the residue at this point, it will be found that the bacteria are not entirely washed away, but are evidently very much reduced. They occur singly, while in the un-washed feces they are in great lumps and masses. I do not believe that it is practicable or even possible to wash the feces entirely free from micro-organisms.

"Strasburger recommends that the wash water be centrifugated for a short time at high speed in order to remove any stray particles of solid residue from the suspension of bacteria. I believe this is a mistake, for if the decanting is carefully done in the first instance, then in my experience the sediment obtained with the second centrifugation is composed wholly of bacteria which would be lost if this part of the procedure was always carried out. The suspension of bacteria is then mixed with a liberal portion of alcohol and evaporated slowly at a temperature of 40° to 50° C., until it amounts to not more than 50 cubic centimeters in all. This takes approximately twenty-four hours. It is then mixed with at least twice its volume of alcohol, preferably absolute alcohol, although this is expensive and not necessary. This lowers the specific gravity of the fluid to such an extent that now the bacteria readily centrifugate out. The mixture is then centrifugated until the supernatant liquid is quite clear. This may take thirty minutes or more for each tube. The residue, which consists of the bacteria, is washed with pure alcohol and is shaken

ith ether to remove the fat; then it is washed out again with  
ol. All of this washing is done by means of the centrifuge. The  
ria are next washed out of the tube with a little alcohol and  
rated to dryness, dried in the oven at moderate heat, dried in  
lesiccator, and weighed. Smears of the final preparation show  
it consists of bacteria with a few very minute particles of other  
rial. These particles are only visible with high power and are  
few in number, perhaps two to each field of the  $\frac{1}{12}$  lens. They  
with methylene-blue, and Strasburger suggests that they are  
lose, which they may well be. At any rate, the error arising from  
clusion of these small particles in the dried weight of the bacteria  
be very small, and is probably balanced by the bacteria that it is  
possible to wash out of the residue in the first washing. During  
reparation of the bacteria the first portion of 5 cubic centimeters  
been dried and weighed. We then know the dried weight of 5  
centimeters, the weight of the dried bacteria in 5 cubic centi-  
rs, the original volume of the stool, and the volume after the  
ion of a known amount of water. It is then easy to calculate the  
we desire, namely, the volume of the stool, its dried weight, the  
ht of the dried bacteria, and the percentage of bacteria in the  
l weight."

In considering the fermentative (decomposition of carbohydrate  
fats) and putrefactive (cleavage of proteids) processes from the  
ipoint of their products, so many factors must be taken into con-  
sideration in the examination of feces that, as yet, only an assumed im-  
pence can be deduced from the substances obtained and their amounts.  
ing the urine having only indol and urorosein out of consideration,  
ust be recollected that the fermentative and putrefactive processes  
lly overlap, and that substances in common (as carbon dioxide and  
ile fatty acids) are found in both. Still, substances containing  
ur or nitrogen, or both sulphur and nitrogen, are formed during  
faction and very probably are the important sources of toxicity  
the intestines. It is known that carbon dioxide, methane, alcohol,  
he oxalates are encountered in the largest quantities in the fermenta-  
of carbohydrates, and that in this is an element of practical  
icance, although it must not be forgotten that they may also be  
ed in putrefactive processes. Putrescin, cadaverin, phenol, cresol,  
skatol, and the gaseous sulphur compounds—mercaptan and  
ogen sulphide—are more regularly found in increased amounts in  
utrefactive conditions.

Our present-day knowledge of these substances does not warrant  
i attaching too definite clinical conclusions to the finding of each

one of these substances (excepting possibly indol and sulphurated hydrogen), and, furthermore, it is unfortunate that the microscopical examination of the feces usually leaves us clinically in the dark. From it, however, some clinical deductions can often be made by the gas formation from feces, which, of course, varies with the types and number of organisms, and the amount and character of food present. I have observed that in health a dextrose-bouillon medium (2 per cent. sugar) inoculated with a floral suspension in normal salt solution will form between 20 to 30 per cent. (by volume) of the gas in the anaerobic limb in twenty-four hours. Herter has shown that in conditions of disease the gas-production was found to be considerably less than the average in health; but this is not true for all of the putrefactive conditions, for, in the true cases of the indolic type it is generally very much increased. In the case of well-marked examples of saccharobutyric putrefaction the gas-production may be one-half, one-third, one-fourth, or even one-fifth of normal. This he attributes to an elimination of the colon bacillus. When yeast organisms, or a growth of the bacillus lactis aerogenes are present, the gas-production may be very abundant. In examining mixed flora, a diet containing large amounts of carbohydrates leads to a greater proportion of gas than a diet in which these are restricted. The decrease of gas on a meat diet may be 40 or 50 per cent of the total gas-production found in a mixed diet. These are factors which must be taken into consideration in interpreting the examination of feces.

The important gases obtained by feces examinations are hydrogen~~19~~<sup>38</sup>, nitrogen, marsh gas, carbon dioxide, and sulphurated hydrogen. The varying proportions of these in health depends upon the character and amounts of foods, upon the character of the bacterial flora present and the pathology of the digestive tract. Estimates of the amount of the different gases obtained from feces on various diets are as follows: hydrogen 50 per cent. in milk, 2 per cent. in meat, and 3 per cent. in vegetable diets; nitrogen, 37 per cent. in milk, 50 per cent. in meat, 15 per cent. in vegetable; marsh gas, 0.09 per cent. in milk, 31 per cent. in meat, and 50 per cent. in vegetable; and carbon dioxide, 12 per cent. in milk, 10 per cent. in meat, and 27 per cent. in vegetable diets. Hydrogen sulphide is also always present (since it can be demonstrated in examining normal feces and produces sulphides from metallic medicaments in the intestines under all conditions—iron and bis-muth salts, etc.). Carbon dioxide is partly due to alcoholic and butyric acid fermentation and partly to albuminous putrefaction. A portion is no doubt derived from the blood, passing through the mucous membrane of the gastro-intestinal tract. In certain neuro-

gical conditions, mainly hysteria, large quantities of carbon dioxide are often discharged. Marsh gas is formed during the fermentation of cellulose, and a portion is derived from albuminous putrefaction. Hydrogen sulphide is produced early in putrefaction in the large intestine, and under pathological conditions (gastric dilatation) may be formed in the stomach and high in the small intestine.

Most of these gases, when small in quantities, are, no doubt, absorbed into the circulation probably without particularly deleterious effects on the body. With hydrogen sulphide, however, there is much reason to believe that when it is absorbed in excessive amounts it has a toxic effect on the nervous system, producing such symptoms as dizziness, tedium, mental depression, drowsiness, stupor, and collapse. In the charobutyric type of chronic excessive intestinal putrefaction, butyric acid, hydrogen, carbon dioxide are formed (and often also methane).

Because of the fact that often little of practical value can be learned from simply viewing Gram-stained specimens of the feces, so that more or less doubt may exist by using the gas tests unsupported by quantitative estimations of the food content and the living bacteria present (the last two of which are too complicated for ordinary clinical application), Schmidt has advanced a method of more quickly and simply noting the fermentative changes of foods on the basis of the continued digestion of the carbohydrates in the feces. Hewes and Miller,<sup>3</sup> who undertook an exhaustive series of observations on normal individuals to establish the reliability of the results obtained from the Schmidt diet in eleven individuals (6 in children and 5 in adults), claim to have found a practical degree of constancy in the observations. They made quantitative determinations of the total nitrogen, fat, and carbohydrates, and of the total neutral fat, fatty acid, and soap in each of the feces in addition to performing macroscopic and microscopic examinations of the feces in respect to the quantity and quality of the muscular tissue and starch remnants present. Their findings of meat remnants, as measured by the capacity of the individual to digest meat, showed a constancy in both children and adults, and any one familiar with the normal findings can determine by microscopic examinations of the feces whether or not the results obtained are abnormal and indicative of a disturbance of meat digestion. The results of their proteid estimations expressed in nitrogen excretion are as follows:—

Per cent.

Average finding in 17 examinations upon 11 individuals.....	4.98
Minimum finding in 17 examinations upon 11 individuals.....	4.41
Maximum finding in 17 examinations upon 11 individuals.....	5.40

The findings as regards fat absorption, determined by estimation of the total fat content, indicate that the capacity of normal individuals

for the utilization of fat as food may undergo considerable variation, as the following table shows:—

	<i>Per cent.</i>
Average finding of 17 examinations upon 11 individuals.....	28.5
Minimum finding of 17 examinations upon 11 individuals.....	19.2
Maximum finding of 17 examinations upon 11 individuals.....	39.5

The estimations of fat digestion, as determined by the proportion of neutral fat to total fat, gave fairly constant results in all instances.

Examinations of the carbohydrate remnants were made on seven individuals, two of whom were children. The findings in the children and the adults were about equal as far as individuals of the same age were concerned, but there was a decided difference between the young and the older persons, the latter utilizing them to a greater extent. Their record of the carbohydrate excretion is shown in the following table:—

	<i>Per cent.</i>
Average finding of 7 individuals.....	8.01
Minimum finding of 7 individuals.....	6.39
Maximum finding of 7 individuals.....	11.3
Extreme variation in all cases.....	4.81

The results in regard to starch remnants, as revealed by a microscopic examination of the feces, presented a striking uniformity in all the normal individuals examined.

The examination is made after the patient has been placed on the following test-diet (Schmidt and Strasburger's test-diet No. 2): milk, 1.5 liters; 3½ eggs; strained oatmeal gruel (from 80 grams of oatmeal); 100 grams of zwieback; 20 grams of butter; 20 grams of sugar; 125 grams of steak (raw weight), and 190 grams of potato (raw weight). These foods can be given as one chooses, but before commencing with the diet it is necessary to demarcate the fecal material by giving a wafer or capsule containing 0.3 gram of powdered carmine. The examination is made as soon as the feces are no longer colored red, viz., after from two to three days of the test-diet. A schedule for the administration of the diet which serves the purpose is as follows: At 7.30 A.M. ¾ liter of milk and 2 zwiebacks (each 33 grams); at 10.30 A.M. ¾ liter of bouillon with ½ egg; at 12 M. ¾ liter of milk with 1 egg; between 1 and 2 P.M. ½ liter of oatmeal gruel (prepared from 40 grams of oatmeal, 166 grams of milk, 10 grams of sugar and ½ egg); 100 grams of well-done Hamburg steak (125 grams of raw beef, raw weight) and 12 grams of butter; 250 grams of mashed potato (from 190 grams of potato, 60 grams of milk, and 8 grams of butter); at 4.30 P.M. ¾ liter of milk, 1 egg, 1 zwieback; at 7.30 P.M. ½ liter of oatmeal gruel, as at dinner time.

each experiment 5 grams of fresh feces are used (the feces being uniform consistency; otherwise a little more or less is taken according to about 1 gram of dry residue). The material is well stirred in water in the bottle *a*, which is then filled entirely and closed with a rubber stopper, care being taken to exclude bubbles of air. *a* is filled with water and also closed without the admission of air. *a* should be empty to allow displacement of the water from tube *b*. Gas collects in it; a small pinhole at the top of tube *c* permits this movement to occur. The communicating tube *b* is adjusted in the figure. The apparatus is then placed in the water-oven at 37° C. for 24 hours, not longer. During this time carbohydrate fermentation will have been completed. During the evolution of gas, it will be displaced from *b* into *c* and the column of gas in *b* is measured and thus the degree of fermentation. The result is considered positive if more than a quarter of a milliliter of gas is obtained. With the test-diet indicated, this would mean a condition approximately normal. In such an event the patient should remain on the diet for two days longer on test-diet No. 1, the same as No. 2 with the absence of meat and potato. If then there is still a marked increase in the result the diagnosis of "fermentative dyspepsia" is justifiable. In order to eliminate the possibility of rising from possible formation of gas due to intestinal albuminoid putrefaction, the following fecal material should be tested from time to time in a control specimen. If the gas obtained is due to carbohydrate fermentation, there will be an increasing degree of acidity (tested with blue litmus paper); this increase, however, is not always marked; at any rate, there is no increasing alkalinity (tested with red litmus paper).

The use of the Schmidt fermentative tubes answers a fair practical question. Of course, the diagnosis of "fermentative dyspepsia" can be made by their employment, but the conclusions as to what this is due to remain somewhat of a question. This is partly due to the form of diet used to make the gas estimation. The Schmidt test-diet is regarded as about as perfect as it is possible to devise food values in the gut for the estimations (although the more simple one

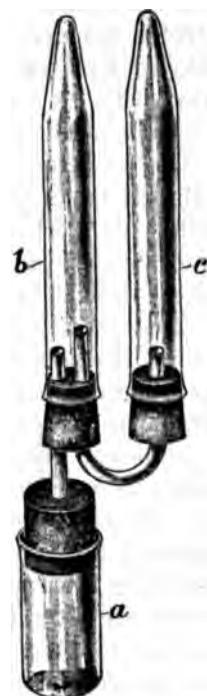


Fig. 68.—Schmidt's fermentation tubes. (One-third actual size.)

## EXAMINATION OF THE FECES

practical of institution and just as efficient as water media than plain water so as to permit this is desirable. Then again, it serves some purpose to note which gases are present, or which are given off in increased amounts, and it is desirable to determine more accurately than just one-fifth, the gaseous volumes. For these reasons, and because the method of bacterial growth can be used, and a means to note the reaction during the tests, I have adopted the gasometer apparatus mentioned in connection with the examinations of gastric contents, a cut of which and description (Fig. 69.)

The apparatus is filled with a watery suspension of feces or a 2 per cent. dextrose in bouillon or plain water. For a biological test, or the unfiltered test-meal in the case of the feces, 7.5 grams of the stool (corresponding to 1.5 grams of the soft, 3 grams of the firmer, or about 10 grams of the hard) are weighed and mixed in 25 cubic centimeters of water (the use of a wooden spoon is useful in crushing the feces, and it is well to remove the large particles of cellulose substances from the nutritive media, a drop or two of the watery suspension of the feces itself is used to inoculate the tube). The fermentation tube is then placed in the water-oven, kept at 37° C. for 24 hours at a temperature of 37° C. when the observations are made. It often happens in the watery suspension that when the cork is removed, much of the feces has risen to the top of the bulb and the gas will be seen incorporated with it. In such cases the gas may be secured in a body by dropping a few drops of water into the bulb and then filling it to overflowing with water. The cork is then tightly fitted into the opening (so that no air is contained in the bulb) and the entire instrument is shaken so that the gas floats up the floating fecal mass. Before the cork is withdrawn, the gas from the upright limb that may have escaped into the bulb is passed back again into the upright tube by inclining the apparatus, after which the cork can be taken out, some of the excess fluid is removed, and the examination can proceed. First, the total gas volume is noted, and then the quantity of carbon dioxide is ascertained by introducing into the upright tube, by means of pipette *b*, 1 or 2 cubic centimeters of a saturated solution of sodium hydrate, and the tube is inverted so that this heavy solution is permitted to run high into the inverted limb. In from fifteen minutes to one hour all of the CO<sub>2</sub>

will have been extracted from the gases present, and the rise in the fluid corresponds to the amount of this gas. The noting of the quantity of carbon dioxide present is not only of some value clinically, but its extraction is necessary for the future observations.

The attachment of the twin bottles is now placed on the upright limb, and when the cock is opened the gases can be driven through the bottles by means of the attachment *e*. Bottle *c* is used to note the

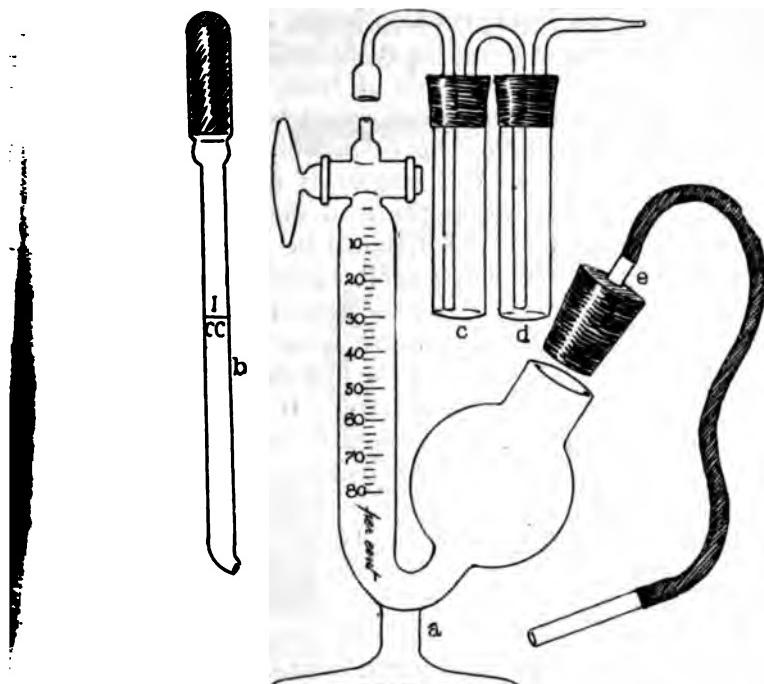


Fig. 69.—Author's gas, chemical and bacteriological apparatus for the examination of gastric contents and feces.

reaction of the gases. For this purpose it is three-quarters filled with a very weak solution of neutral azolitmin (using one-half of it in a test-tube for a control), or three-quarters filled with plain water in which are placed small pieces of phenolphthalein paper (to note alkalinity—turns red when ammonia is present), and methyl-orange paper (to note acidity—turns red with the volatile acids, butyric, acetic). In the use of the paper method, I would advise that one of the papers be cut in squares and the other triangles. Bottle *d* notes the presence of hydrogen sulphide. For this purpose, the bottle is three-quarters filled with a 10-per cent. solution of lead acetate, which turns dark or black from the

formation of lead sulphide. The gases are blown through the bottles very slowly, preferably not more than one bubble at a time. A lighted match may be held at the end of the outer tube to note the presence of marsh gas, but, as hydrogen is usually present and also burns with a blue flame and marsh gas is not of so much practical value, this part of the test may be omitted. Usually when marsh gas is present, the reactions in the bottles are both positive. The elimination of the CO<sub>2</sub> in the first instance is essential because this gas is always present more or less and gives an acid reaction in the reaction bottle, and also because it interferes with the burning of the gases at the outlet.

In the use of the watery suspension of feces, the food values the same must be controlled by means of test-diets or the results will not be constant. For this purpose the Schmidt-Strasburger diets can be used, but the following which I employ is much easier and practical for all of the feces tests—the food digestibility includes With this diet only a few meat fibers should be seen and the other elements be well utilized (iodine or Lugol's solution may be used to stain the starches). The diet list I give the patient is the following:

**Directions.**—The diet mentioned below is to be strictly adhered to for three or four days. The stools of the first thirty-six hours after its institution are of no value for examination. If constipation exists the bowels are to be moved by an injection at the end of the thirty-six hours. After this time, providing the bowels have moved well, the entire first stool is to be sent as soon as possible, no purges being taken in the meantime. Fresh specimens are desirable, and a covered small tin can or a glass jar can be used as a container. A twenty-four hour collection of urine should be sent with the specimen of stool.

**DIET.—Morning.**—Two thin slices of well-baked bread with butter liberally applied; one pint of oatmeal gruel, made of about 1½ ounces or 40 grams of oatmeal, ¼ ounce or 10 grams of butter, 6 ounces or 200 grams of milk, 8½ ounces or 300 grams of water and 1 egg (strained).

11 A.M.—Milk, ½ pint or 250 grams.

**Noon.**—A good-sized piece of steak, or roast beef, chopped or cut into very fine pieces, about 4 ounces or 125 grams and served on a slice of toast; 1 bowl (about 8 ounces or 250 grams) of mashed potato with ¼ ounce or 10 grams of butter.

4 P.M.—Milk, ½ pint.

**Night.**—Same diet as breakfast.

With the use of the nutritive media, the test-diets are a negligent feature, since the results obtained pertain more particularly to the character of bacteria at work; thus I would advise the general

use of two fermentation tubes in each estimation, one for the clinical and one for the bacteriological tests. The fluid of the media tube can be used at the end of the testing to note the character of putrefaction (indolic or saccharobutyric) by the employment of the usual chemical methods and to study the two types of micro-organisms—the anaerobes in the closed limb, the aerobes in the bulb. If the specimen of stool is high in active *B. coli communis* and a dextrose or any other sugar bouillon is employed as the inoculated media, the sugar will be affected first with the generation of large quantities of gas, and the protein may not be touched for the time being. Should, however, the



Fig. 70.—Hart's food scale with adjustable food dial. Used for weighing food for the digestive power tests and the dietetic treatment of errors of digestion and metabolism. Made by Chatillon & Sons, New York City.

strict anaerobes be a feature in the specimen, notably the *B. aerogenes capsulatus*, then the protein would be affected by the *B. coli* more quickly and more completely, but not until a marked fermentation of the sugar had taken place. While both in fermentation and putrefaction  $\text{CO}_2$  and the volatile acids are encountered, the sulphur and nitrogen compounds are not so, being only derived from protein putrefaction. In the inoculation of the dextrose bouillon, 20 to 30 per cent. of gas may be considered as normal; in saccharobutyric putrefaction the gas content is usually only from 5 to 13 per cent. In gastro-enteric atrophy the gas content, in my experience, in well-advanced cases, runs to 80 per cent. In the watery suspension of feces when food such as a normal

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individual ordinarily uses has been continued, and the proportion of feces and water employed as mentioned above, the gas limits may be considered as from 10 to 30 per cent. On a meat diet it may fall to one-half of these figures, and on a strictly carbohydrate diet it is usually higher.

REFERENCES.

<sup>1</sup> HERTER: "Bacterial Infections of the Digestive Tract."

<sup>2</sup> STEELE: "Progressive Medicine," vol. iv, Dec., 1907.

<sup>3</sup> HEWES AND ADLER: Boston Medical and Surgical Journal, 1908, clviii, No. 19, p. 655.

## CHAPTER IX.

### Diagnostic Significance and Examination of the Blood and Urine in Gastric Diseases.

#### THE BLOOD.

THE examination of the blood in a general way is not of as much diagnostic value in gastric diseases as it is to separate these diseases from others in which gastric symptoms exist. Still, certain blood changes commonly accompany several of the primary stomach and intestinal affections, and since these may have some diagnostic and therapeutic significance, they should be mentioned.

It is probable that in the years to come some practical facts will be established in the examination of the blood which will serve to make possible diagnoses of carcinoma of the internal structures of the body. It has always appeared to me that the light will dawn by finding either by direct examination of the blood, or in the urine some specific toxic substance. In the mass of past work and literature upon the subject, it may be stated that but little of diagnostic importance is to-day at hand. Still, some laboratory facts have been gleaned as rather constant features, although, unfortunately, a negative or a positive result from any or all of them cannot definitely be used to either exclude or make a diagnosis of cancer. Up to the present time these briefly are the following:—

Sugar is a normal constituent of the blood where it is present in amounts varying between 1 and 1.5 pro mille. This substance is increased in amounts in diabetes, and to a less extent in carcinoma and the infectious diseases. According to Drinkler,<sup>1</sup> large quantities of reducing substance, most of which is sugar, is met with in carcinoma of the internal organs, and this increase can be utilized to differentiate cancer from sarcoma, in which latter condition it is lacking. This observer, following Freund, states that in carcinoma the average percentage increase is double that of typhoid fever and pneumonia, running in figures between 0.1023 and 0.3030 per cent. It is probable then, since none of the other diseases (excluding diabetes) give a maximum per cent. much over 0.1, that 0.2 per cent., more would argue in favor of cancer.

The procedure for these estimations (Cavazzani) is to obtain 20 or 30 cubic centimeters of blood by venesection or aspiration of one of the arm veins (median-cephalic), and to free the blood from proteids. To this end, the known quantity of blood is added to 200 cubic centimeters of distilled water in a porcelain dish, treated with 5 or 6 drops of a solution consisting of 10 parts of acetic acid (sp. gr. 1.040) and 1 part of lactic acid. The mixture is boiled for about ten minutes, filtered, and the coagulum repeatedly washed with hot water and finally pressed out in a piece of muslin. The filtrate is evaporated to a small volume over a water bath, and if necessary further cleared of albumin by again filtering, or by the addition first of a few crystals of sodium carbonate when the reaction is distinctly acid, or a few more drops of acetic acid when it is not. In the final filtrate the sugar is estimated by the usual methods as employed with urine.

In the secondary anemia of carcinomatosis the color index is usually low, and the oligocythemia permanent and in degree depending upon the course of the disease, although it is rarely as low as in pernicious anemia with which an achylic stomach is also commonly present. A granular degeneration of the red cells is more or less constant, although not so marked a feature as in pernicious anemia, lead poisoning, and malaria. Poikilocytosis is usually constant, depending on the degree of anemia and the stage of the disease, but the megalocytes and megaloblasts are rarely observed and, if so, are very few. In pernicious anemia these latter cells are characteristic findings.

A physiological leucocytosis is observed during the process of digestion, reaching its height between the third and fourth hour after the ingestion of foods. The increase in leucocytes affects the polynucleated elements and the lymphocytes (especially the latter), and may normally range as high as 3500 in adults, depending upon the amount of protein content in the foods. Under certain pathological conditions, notably cancer of the stomach, this digestive leucocytosis may not occur, and this was advanced by Schneyer as a factor of assistance in the diagnosis of this disease. While this digestive increase in the white blood-cells is commonly absent in gastric cancer, in about 10 per cent. of the cases it is seen even quite late in the disease, providing the pylorus is patent and the chemism of the stomach is somewhat preserved. In the benign stenotic conditions of the organ, the presence of a digestive leucocytosis is the rule, while in the markedly stagnant conditions of the organ (which are almost invariably malignant) an increased leucocyte count is rarely present, and, if so, the increase seldom reaches an additional thousand or so. To observe this, the first blood-count should be made with the patient in bed and after having fasted for about seventeen hours, when

a test-meal of a pint or more of milk and one or two eggs should be given, and the second or third blood-count made three or four hours afterward.

It should always be remembered that, if much ulceration accompanies the malignant process, the primary count may be high and the digestive leucocytosis apparently present may be from stimulation of the septic area and resorption of fluids from the foods. A high leucocyte count commonly exists when much gastric hemorrhage is present.

In acute gastric ulcer, a low color-index and red-cell count is seen in the majority of cases, particularly after a hemorrhage of some extent (at these times the white-cell count may be high). Poikilocytosis is rarely present unless the bleeding has lasted for some time when the secondary anemia may be marked and a few malformed cells be observed. When chlorosis exists, the oligochromemia exceeds the corpuscular loss, and the color index may have fallen to 0.3 or lower. Other cases again display no change in the blood examinations, and particularly is this true in the subacute ulcerative conditions and in the chronic ulcer.

In both acute and moderate grades of chronic gastritis the red cells are not diminished. In the severe types of the chronic disease an oligocythemia and blood picture of red-cell degeneration may be so marked as to make a differentiation most difficult between it and true pernicious anemia. Occasionally, in chronic gastritis, granular red cells are seen with granules of the larger type, such as are characteristic of pernicious anemia. Poikilocytosis is common in the cases of gastro-enteric atrophy, but the facts that the color-index is low, the red-cell count is usually not under 2,000,000 (Henry<sup>2</sup> gives 1,500,000 as the limit), and megalocytes and megaloblasts are not encountered, serve to distinguish the blood picture from that of primary pernicious anemia. In suppurative gastritis a leucocytosis is of rather constant occurrence, or the neutrophiles are relatively increased and the eosinophiles much decreased or absent altogether (the latter is the so-called septic factor of Simon<sup>3</sup>). In a fatal case of phlegmonous gastritis due to streptococcus infection, I observed a leucocyte count of 32,000, and I believe that the blood-examination in these difficult-to-diagnose cases is of inestimable value for diagnosis.

In the neuroses, unless a simple anemia is present, no practical data can be gained from blood-examinations. The same may be said of primary gastric sarcoma until very late in the disease, or in the metastatic forms even to the very end. One of my cases of multiple sarcomata in a man (which came to autopsy and had twenty-seven sarcoma nodules in the stomach walls), had a red blood-count of

3,700,000 and a color-index of 0.79 and a white-cell count of 9100 only ~~by~~ three days before death.

In these examinations much information may be quickly gained ~~and~~ by the examination of a wet mount, in which, after a little practice, ~~one~~ a fair idea of the grade of the anemia, the degree, character, and ~~the~~ extent of a leucocytosis may be obtained, as well as malarial parasites ~~are~~ seen. The lobe of the ear or tip of the finger should be deeply punctured ~~one~~ by a lancet or a Hagadorn needle so that the blood flows freely, and the ~~the~~ observation made (between a slide and cover glass) before crenation has ~~been~~ occurred. Fixation and staining of dry mounts are always essential for more detailed examination. The blood-counting apparatus of Thomas ~~and~~ Zeiss for both the red and white cells is the apparatus commonly employed for enumerating the blood-corpuscles, although the Simon is easier ~~to~~ to compute from, and the hemometers of Fleischl and Dare are clinically ~~very~~ the most convenient for the hemoglobin estimations. For fuller details on the methods and technique of blood-examination the reader can consult some work on blood-pathology or clinical diagnosis.

### THE URINE.

Although but little can be gained from the examination of the urine in primary disease of the stomach, still, this detail of examination should never be omitted in gastric diseases because of its diagnostic value in constitutional disorders, local disorders of the kidneys, intestine, heart, liver, and so on, which, in a given case, may be causing gastrointestinal symptoms as the cardinal features. The significant points in urinalysis in gastric disorders will be considered.

The quantity of urine is commonly increased in diabetic conditions, in arteriocapillary sclerosis, in amyloid disease, and in functional disorders of the nervous system—particularly in hysteria, chorea, and migraine. In arterial sclerosis of the splanchnic area a moderate increase in the amount of urine is an important symptom. It is rare to find in the primary gastric neuroses (even when of marked degree) any noticeable difference in the amount of urine voided, but in atonic conditions of the stomach (in which excessive thirst is common) the amount of urine will be correspondingly increased. Not accurate conclusions regarding the degree of motor disturbances as judged from the quantities of urine voided can be made, since even in stagnant conditions of the organ, where high degrees of dilatation and atony exist, the urine may be normal in quantity. Oliguria, on the other hand, is often met with in digestive disorders. It is common in debilitated and asthenic subjects probably because of low blood-

pressure, weak heart action, or the taking of insufficient fluids. Following diarrhea, persistent vomiting, or hemorrhage, a low urine excretion is the rule, and this is also true in the long-continued fever of carcinoma, or when a secondary nephritis has been established from organic or malignant disease elsewhere in the body.

Normally, the reaction of the collected urine of 24 hours is acid, and the degree of acidity is greatest in the morning, and in concentrated urines. If the diet consists purely of vegetables, or after the ingestion of a large meal of any kind of food, the reaction may be temporarily alkaline. This digestive change in urine reaction is taken advantage of to diagnose the status of gastric secretion, but in my experience results from it are far from satisfactory. It has been advanced that, when after a meal the urine loses part of its acidity or becomes alkaline, hydrochloric acid secretion exists, depending in amount upon the degree of acid loss in the urine, or that organic acids are being formed in the stomach; and *vice versa*, that when this physiological lowering of acidity is not present in urines after the ingestion of the principal meal it speaks for deficiency or absence of HCl secretion. While this urinary condition exists in the majority of such cases, still, so much variation occurs that definite conclusions should never be made from the urine examination alone; this variation is due to the quantities and character of foods taken, and the fact that this rise and fall of urine reaction, in even normal individuals, may not exist to any appreciable extent. I have observed anachlorhydric cases with an evenly running low acid or fixed alkaline urine, and cases of increased acid secretion wherein but slight if any lowering of the post-meal acidity of the urine could be noted. It is also probable that in certain anemic, neurasthenic, or debilitated individuals this rise and fall of acidity is interfered with by the constant low grade of acidity seen in these conditions. In persistent vomiting and severe motor disturbances of the stomach the urine is often alkaline.

The total acidity of urine can be estimated, according to the Folin method, as follows: 25 cubic centimeters of fresh urine are treated with 1 drop of  $\frac{1}{2}$ -per-cent. alcoholic solution of phenolphthalein and 15 grams of powdered potassium oxalate. The solution is well shaken, and titrated at once with decinormal sodium hydrate solution (under constant agitation) until a faint pink color is obtained; the result represents the acidity due to diacid phosphates and free organic acids, and is figured in total amount of urine voided in twenty-four hours, and is expressed as T.

The next step is to determine the total phosphates, the value being termed P. For this we employ a solution of uranium nitrate

of such strength that 20 cubic centimeters shall correspond to 0.1 gram of  $P_2O_5$ ; a solution containing sodium acetate and acetic acid; and a tincture of cochineal. Fifty cubic centimeters of clear, fresh urine are treated with 5 cubic centimeters of the acetic-acid mixture, the object being to transform the monoacid sodium phosphate present into diacid sodium phosphate and to neutralize any nitric acid that may be formed during titration. A few drops of cochineal tincture are added, the mixture heated to boiling, and then titrated when hot with the uranium solution. The results are calculated according to the amount of uranium solution used. For example, if 15 cubic centimeters of titrating solution are employed, the  $P_2O_5$  in 50 cubic centimeters of urine is found from the equation:  $20:0.1::15:x$ ; and  $x = 0.075$ . The percentage amount would then be  $0.075 \times 2 = 0.15$ , and if the total amount of urine was 2000 cubic centimeters the elimination of  $P_2O_5$  would be 3 grams.

For the final result for computation between the two foregoing estimations, an expression of the latter in terms of decinormal acid is necessary, viz., alkali as in the first ( $1\text{ c.c. } \frac{N}{10} = 7.1\text{ mgs. of } P_2O_5$ ).

The T minus P indicates the acidity due to uncombined organic acids, and the difference the mineral acidity. The average figures which Folin obtained in twenty-four-hour urines from normal individuals was 617 (c.c.  $\frac{1}{10}$  N. acid, viz., alkali), of which 304 represented mineral and 313 organic acidity; and these figures may be considered as a standard for estimations.

The total phosphates, estimated as above, are often found increased in sufferers from digestive disturbance. The normal amount secreted in twenty-four hours usually runs between 2 and 3 grams, but in states of excessive HCl secretion, anemia, in nervous individuals, and carcinoma, this may run as high as 6 to 12 grams.

The chlorine content of urine in the diagnosis of digestive disorders has received more attention than the other inorganic substances. This was probably because of the presence of HCl secretion in the stomach and the hope that some facts of diagnostic value might be gained concerning this. Unfortunately, the observations reported in the total chloride estimations leave much to be desired, and the estimations cannot be taken as of much practical value. In the greater number of instances of hypersecretion, gastric ulcer, atony, and carcinoma the chlorides are considerably diminished, but this cannot be depended upon as always being so, and, consequently, I have discarded these estimations as a measure of diagnosis or observa-

tion in these conditions. In diarrhea, anemia, the nervous affections, and infectious diseases (particularly pneumonia), a decrease is commonly encountered. The Salkowski-Volhard method serves to the best advantage in these estimations.

Sulphuric acid occurs in urine in two forms: first, the mineral sulphates in combination with sodium and potassium; second, the organic sulphates in combination with indol, skatol and phenol—the first are termed the inorganic or preformed sulphates, the latter the conjugate or ethereal sulphates. The total daily excretion of both varies between 2 and 3 grams, and the relation between the preformed and conjugate combinations is respectively as 10 to 1.

In the study of digestive diseases the preformed sulphate examinations may be disregarded, as they are not of value, excepting should the ratio between the two kinds be desired (such as in a high increase in the conjugate form), and thus only the relative importance of the preformed form (indol) will be considered. When albuminous substances are undergoing putrefaction in the intestine, or rapidly decomposing in any part of the body, as in chronic excessive putrefactions in the intestine, accumulations of putrid pus, septic peritonitis, empyema, etc., indol is formed.

This substance when absorbed into the circulation is oxidized, forming indoxyl, and the latter unites with the preformed potassium sulphate to become the conjugate potassium indoxyl-sulphate, or, as it is commonly termed, indican. If indican, which is colorless, is treated with strong acids and oxidizing agents it is decomposed, with the formation of indigo blue, the color of which is readily recognized.

Indican, urohematin and urorosein, in my opinion, possess much significance in the diagnosis and therapy of digestive diseases. But since in this volume we are concerned chiefly with disorders of the stomach, their direct importance in intestinal disorders will not be included, and only their effects in the production of gastric symptoms will be considered. In entering upon this, the author wishes to express his belief that these products, when present in the circulation for any length of time (as they commonly are in the putrefactive conditions in the intestines), have a depressing effect upon the secretory apparatus of the stomach and the general nervous system, and may cause low degrees of nutritional changes in the body, all of which may be strong factors in the production of gastric symptoms. After a rather close attention to this subject, I cannot agree with many of the well-known authors on gastric diseases by accepting the condition of indicanuria in any negative or light vein in the diagnosis or therapy of stomach disorders. It is doubtless true that when indicanuria was first

stated to be of significance, too much hope had been built upon the presence or absence of increased amounts of indican in the differential diagnosis of intestinal conditions, but it must never be forgotten that these products merely represent intestinal putrefaction, and that this may or may not be present in any disease of the intestines, cancer included. But while this is true, states in which increased amounts of indican (or allied substances some of which no doubt are still unknown) may be the cause of gastric symptoms will not progress favorably unless the primary source of the excess of indican had received attention. Excessive production of indican then is of importance in functionally producing gastritis symptoms, and tests for this should never be omitted in the diagnosis of stomach disorders. As our knowledge of the present day is still meagre on the entire subject of these putrefactive products, and that the tests for indican are the simplest and best known, those for this substance have to be considered as most representative and diagnostic of these conditions.

Indican is present in small quantities in healthy urines. According to Simon, and I fully agree with him, an excessive secretion of indican is often indicative of a decreased quantity of hydrochloric acid in the gastric juice, and, leaving out of consideration the direct and transient inhibitory effects of indicanuria upon the stomach secretion, an excess secretion of indican may be found in cases of low or absent gastric juice secretion (such as in hypochlorhydria, anachlorhydria, or achylia), acute and chronic gastritis, gastro-enteric atrophy, cancer, and in diseases or obstruction of the small and large intestine, even when the stomach secretion is normal. But it is also true that a high output of the ethereal sulphates may exist in the sthenic conditions of the stomach, namely, acute congestions and inflammations, and the hyperacidities, hypersecretions and even hypermotilities. Therefore, an indicanuria cannot be taken as indicative of an asthenic stomach condition, for the reason that in most instances the indicanuric condition at first accelerates the stomach functions before it depresses them. Clinical experience has proven to me that in most of the cases of chronic intestinal putrefaction of the indolic and combined forms, the low status of stomach function noted, including even stomach and intestinal atonies, are resultant rather than causative states. My reasons for this belief are mainly because high indicanuric states with hypersecretion and hypermotility are even more commonly encountered than are those with impairment of stomach function, and that an improvement in the intestinal condition often shows a secondary beneficial change in the stomach. A high protein diet usually increases the output of the ethereal sulphates, and a carbohydrate or exclusive milk diet usually diminishes it.

The most generally used test for indican is by means of the Obermayer reagent, which is a 2 pro mille solution of ferric chloride in concentrated hydrochloric acid. A few cubic centimeters of urine (about 5 cubic centimeters) are mixed with an equal volume of Obermayer's reagent, and shaken with a small amount of chloroform (about 1 cubic centimeter), which last takes up the indigo blue which is shown after the test-tube has stood for a few moments (when the chloroform settles to the bottom); it may be concluded that a colorless or a light sky-blue coloring of the chloroform is normal, and that a darker blue represents an excess of indican. I observed urines from post-operative cases of ileus in which the chloroform was almost black, and in these instances the urine examinations were the first suggestive findings.

Another test for indican which answers the purpose admirably is the Stokvis modification of the Jaffé test. To this end 5 cubic centimeters of urine are treated with an equal amount of concentrated hydrochloric acid and 2 or 3 drops of a strong solution of sodium or calcium hypochlorite or about 2 cubic centimeters of hydrogen peroxide are added. Chloroform is added as above, and the mixture shaken and permitted to separate, when the colored chloroform can be noted. In both of these tests I believe that better results are obtained by first making the mixture, shaking it well and letting it stand for a few moments before adding the chloroform and finally shaking. After performing the test a few times, the color values of the various amounts of indigo blue will be learned, and thus a practical idea of increased amounts is obtained. Marked tubes containing various amounts of indigo blue in chloroform solution may be made and used for comparisons; at these times the same quantities of urine, reagent, and chloroform should always be used in making the color comparisons, and Jaffé's observation of the mean average of healthy urines may be used as a standard (6.6 milligrams in 1000 cubic centimeters of urine).

The test I now use exclusively is a modification of the Jaffé test and the employment of a centrifuge test-tube as shown. Into this is put chloroform to the 1 c.c. mark, urine to the 4, and concentrated hydrochloric acid to 7. A few moments are allowed to see if the mixture above the 1 c.c. mark is darkening from indican, because many of these urines contain an oxidase which contains sufficient oxygen for the reaction without the addition of more, and in fact the reaction may be inhibited if an oxygen-bearing chemical is added. If no reaction is observed, a few drops of hydrogen peroxide are added, a few moments are allowed for the indican to show itself to its depth, the content of

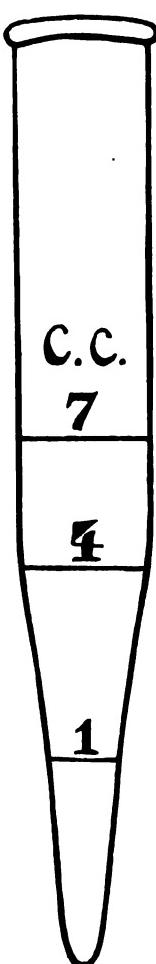
the tube is thoroughly shaken, and then centrifuged. The indican will then be found in the chloroform below, and the uroosein above in the urine-acid-peroxide mixture. With these tubes, measuring as they do the amounts of chloroform and urine, the presence of the chromogens can be noted, as well as a fair idea of the amount of the two important ones in a quantitative way, which answers for routine clinical work.

Urohematin (indigo red) is most likely an indoxy derivative with a clinical significance similar to that of indican. It is more rarely observed than indican, and may be noted in extensive disease of the small intestine affecting resorption, in gastric cancer, and acute and chronic peritonitis (Ewald). It is also met with in ileus, chronic intestinal putrefaction and small intestine obstruction, and, like indican, it is rarely observed in carcinoma and stricture of the colon and esophagus, chronic diarrhea, etc. It is present in normal urine in small amounts, and may be demonstrated by shaking urine with chloroform (about 4 to 1 per volume), decanting it after agitation during several days, when the addition of a drop of concentrated hydrochloric acid to the chloroform will cause the appearance of red color—the deeper the red, the greater the amount of chromogen present.

For the reason that urohematin may be present without an increased amount of indican, the general employment of the Stokvis-Jaffé indican test or the author's modification of it is recommended as a routine for the above-mentioned substances and also uroseinogen. Usually, however, both indican chromogens are present together, when a purplish color will be obtained in the chloroform extract. The so-called "Reaction of Rosenbach" is then a simple and most convenient test for indigo red, and by it tests for both albumin and this substance in increased amounts are noted. It consists of simply boiling the urine in a test-tube and adding drop by drop concentrated nitric acid, when in the presence of large amounts of indigo red a dark Burgundy color is noted.

Fig. 71.—Author's centrifuge test-tube for qualitative and quantitative reactions of indican and uroosein.

The color may be bluish when viewed in the direct daylight, and usually fades out when more than 10 or 20 drops of nitric acid are added (this, of course, is also the common urine test for serum albumin). In the



quickly made tests for indigo red no red color of the substance is noted in normal urines.

Uroroseinogen (urorosein) is another chromogen that may be found in urines. It is also red, but more of a pink rose color than red indican and is probably a derivative of skatol. It is best tested for by the methods above described, when the indican present will be seen in the chloroform below, and the urorosein above in the supernatant fluid, which it colors a beautiful rose color. The latter may now be extracted from the supernatant fluid with amyl alcohol and separated from the other pigments that may be present at the same time by shaking with sodium hydrate, at which the solution is decolorized. Upon the addition of one or two drops of hydrochloric acid to the alcoholic extract the red color of urorosein reappears, quickly fading out on standing. It is interesting to observe that while indican is a representative product of albuminoid putrefaction in the intestines, urorosein is more commonly found in the fermentation of vegetable substances. The following brief history of a case is offered in this connection:—

**E. M.** Female. Single. Age, 38. Mother died of uterine cancer at 42; father of acute enteritis at 51. Weight, 83½ pounds.

*History of Present Illness.*—Began with a red ulcer on tongue 6 years ago, following which she began to have gastric symptoms. In past 11 months has been nauseated constantly and had severe attacks of vomiting lasting several days; has a fitful appetite; sometimes a diarrhea, but never markedly constipated. Always feels full in the abdomen; has gas in stomach and bowels; lost 21 pounds in last 4 years, and 15 pounds in last 8 months, and 6 pounds in 2 weeks.

*Examination.*—Pale, emaciated, and physically weak; looks very ill. Tongue red and clean; lungs and heart negative. Growth in epigastrium just above the umbilicus, which feels like a mass sharply limited to pylorus. Stomach markedly dilated and distended, no peristaltic waves visible.

*Tests.*—Ewald meal, 25 cubic centimeters return, negative to acid papers; lactic acid and blood present; mucus in excess; no Boas-Oppler, but many micrococci and leucocytes. Free HCl 0, total HCl 7°, total acidity 12°. Urine, specific gravity 1016, acid, clear, amber, trace of albumin, no glucose, large amounts of indican, no red pigments.

*Diagnosis.*—Gastric carcinoma?

I saw the case again 5 months afterward, when she had gained 15 pounds in weight; her epigastric mass had disappeared; her gastric symptoms had abated, but her intestinal symptoms were more marked (diarrhea, flatus, etc.), and she was physically weaker and was being assisted about. Her feces showed a high albumin loss, and her urine but little indican but large amounts of urorosein—she was taking practically only cereals, vegetables, milk, and eggs at the time; her urine had ½ per cent. per vol. of albumin, many casts, 5 grains of urea to the ounce, and many oxalate crystals. Her blood count was 2,250,000 reds, 23 per cent. hemo-

globin, color index low, and 7100 whites. The morphology of the red cells was much like that of pernicious anemia with megalocytes or megaloblastic cells.

The diagnosis was changed to gastro-enteric atrophy, and the mass at the pylorus was assumed to have been due to a pyloritis incident to atrophic disease, which condition finally advanced into the intestinal canal, involving the entire digestive tract and probably the pancreas as well. The main interesting features of the case were the presence and then the disappearance of the gastric thickening, and the chromogen change in the urine as the condition advanced.

The distinctly pathological pigments that may be noted in the urine are those of bile and blood. Of these in digestive diseases the coloring matter of bile (bilirubin) is of vast diagnostic importance. As is well known, this chromogen never appears in urine when it is being eliminated in the natural way by the bowel. But when obstruction in the bile-ducts exists, either catarrhal (gastroduodenitis), stenotic from adhesions of the common duct, when occluded by stones, pressed upon by neighboring organs, or by growths in them, etc., a small portion is reabsorbed into the blood and thus eliminated in the urine. Usually the presence of bile can readily be recognized by the color it imparts to urine, its foam when shaken, or sediment when standing. Occasionally, however, doubt exists as to its presence, particularly when in only small amounts, and thus chemical tests for it may have to be made.

Among the many advanced are those of Bonanno, Smith, and Gmélín—the first being by far the more sensitive and satisfactory. The reagent described by Bonanno in 1907 is much more sensitive for the detection of bile pigment than the usual reagents, especially those of Gmélín, Maréchal, and Krokiewicz. The reagent is prepared as follows: into a bottle with glass stopper is placed sodium nitrate (20 centigrams) and 10 c.c. HCl; the bottle is then closed. A saturated solution is thus obtained; it is dirty-yellow, and fumes of nitric acid and chlorine escape from it. The reagent has to be renewed from time to time, as it is apt to lose its strength. One or more drops of the reagent, when added to icteric urine, cause emerald-green coloration at first of that portion which is touched by the reagent; when the test-tube is shaken the coloration is imparted to the entire urine. The green color is permanent; it cannot be obtained when both ingredients of the reagent are added successively to the urine. The reaction is specific; urobilin, indican, acetone, glucose, as well as medicinal agents like phenol, iodine, bromine, and salicylic acid, do not yield it. The presence of these substances in the urine does not disturb the reaction. The reaction occurs by the oxidation of bilirubin into biliverdin; this oxidation is produced in part by the nitric acid, in part by the chlorine.

To perform the Smith test, 5 to 10 cubic centimeters of urine are placed in a test-tube and treated with 2 or 3 cubic centimeters of tincture of iodine which had been diluted 1 to 10 with alcohol. This dilute iodine is carefully floated on the top of the urine, when, if bilirubin is present, an emerald-green zone is noted at the point of contact. The Gm  lin test may be performed by allowing a few drops of nitric acid to run down into a small quantity of urine in a porcelain dish, when a green color is noted as it flows into the urine, or the acid can be delivered with a pipette into the bottom of a test-tube of urine, when the well-known play of colors is noted, of which the green is the most characteristic.

Also of importance in this connection is the aldehyde reaction advanced by Ehrlich. The bile on reaching the intestines through the common bile-duct is reduced by the action of the bacteria into urobilin, which is brown in color and imparts the normal color to feces. The further reduction of urobilin in the lower part of the intestines into urobiligen, which is colorless, is the basis for the test, regarding which M  ller has pointed out its significance and importance in clinical work. The urobiligen is absorbed by the intestines and carried back to the liver by the portal circulation, where it is taken up by the liver cells (providing they are in normal condition) and reconverted into bile-pigment, entering into the biliary ducts and thence to the intestinal tract, thus completing the circuit but not entering the general circulation. If, from any cause, there is a disturbance in the function of the liver, the cells are unable to take up all of the urobiligen, which finally gains the general circulation and is excreted in the urine. Its presence there can be detected by the polariscope or the aldehyde reaction.

The reagent consists of dimethylamidobenzaldehyde 4 parts, and dilute hydrochloric acid 200 parts. A few drops of this reagent added to 1 c.c. of fresh urine (preferably just voided) will give a distinct red color if urobiligen is present. With the polariscope a dark stripe is seen between the yellow and green. The test is usually positive in failing cardiac action until compensation is restored, cirrhosis of the liver, and malignant disease of the stomach involving the liver but not affecting the bile-ducts. Because no bile is entering the intestines in cases of obstructive jaundice or gall-stones impacted in the common duct, the urine tests are negative, but when the obstruction is relieved, the urines from these cases are positive for a time because of the disturbance in the liver function brought about when the obstruction existed, and then negative again when the hepatic cells are functioning normally. The test is also of much value in cases of

urine excessive putrefactions in the intestines to learn if the live ~~t-~~ cells are overwhelmed with toxins from the gut, and; as was mentioned before, as an indicator of the results being obtained from treatment.

Blood likewise can readily be recognized in urine by the color it gives to the sediments. When red blood-cells are present, a microscopic examination of a centrifuged portion is a quick and reliable method. The chemical tests for hemoglobin in urines are the well-known Heller's and Donogany's. A blood derivative known as hematoporphyrin may be present in larger amounts than normal. When so, it usually colors the urine a brown which is deepened standing. To demonstrate the presence of the substance the Garrick method may be employed.

Blood in the urine is rarely met with in the routine of gastric diseases. Occasionally it is noted in multiple sarcomata when deposits are in the kidneys, and late in gastric cancer in very small amounts. Slightly increased amounts of hematoporphyrin are sometimes met with in ulcerative, hemorrhagic and malignant conditions of the intestines. Altogether, the presence of blood in the urine possesses no special significance in the diagnosis of diseases of the digestive canal.

The quantity of nitrogen in the urine in digestive diseases is of some significance, particularly when its output is low; this is noticed in some of the cases of cancer of the stomach and in hepatic and renal disease such as acute yellow atrophy, cirrhosis, insufficient excretion of bile, interference with the circulation in the portal system, Weyl's disease, and in nephritis. Nitrogen itself may be quantitatively estimated by means of the Kjeldahl method (normal output 3 to 4 grams per diem), or the urea, which represents about 85 per cent. of total nitrogen eliminated by the kidneys, may be used in making the estimations (normal output between 30 and 35 grams per diem, depending upon the amount of nitrogenized foods taken and the body metabolism). It has been reported that the urea output in cancer, and particularly cancer of the stomach, may fall as low as 7 to 14 grams. As in all other conditions of the stomach but little or no effect on the output of nitrogen is noted (providing, of course, that sufficient proteid food is being taken), this examination may be utilized as a helpful means of differentiating cancer from the benign conditions, particularly in pyloric stenosis. In deficiency of hepatic function from any cause or interference with the flow of bile the urea output runs low (from 10 to 20 grams) and the uric acid output high (from 1 to 2 grams), the normal amount per day of the latter being about 0.7 gram.

The Kjeldahl method for quantitatively estimating nitrogen depends upon the fact that all organic matter is decomposed by sulphuric acid, when all the nitrogen which is not present in combination with oxygen is transformed into ammonia. The ammonia is secured by distillation, and the quantity of nitrogen is figured from the amount of ammonia present, remembering that 17 grams of ammonia corresponds with 14 grams of nitrogen.

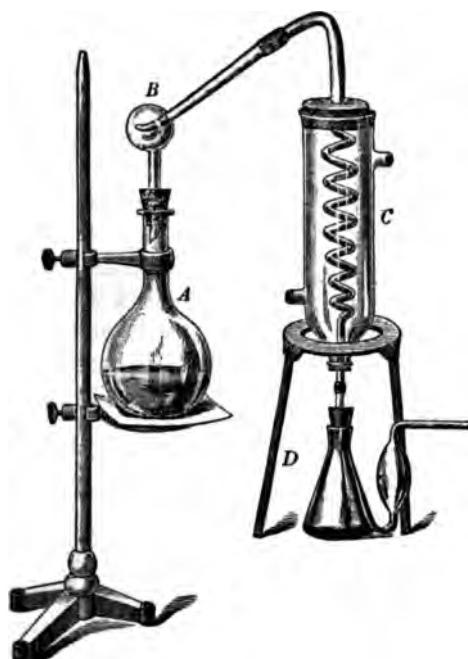


Fig. 72.—Kjeldahl's nitrogen apparatus.

To estimate these there is required a retort of about 750 cubic centimeters capacity (A), which is connected with a Kjeldahl distilling tube (B), and through this with a Städeler condenser (C). The nitrogen is received in the nitrogen bulb (D). A Kjeldahl digesting flask is also required. The reagents required are a mixture of 100 grams of phosphoric anhydride in 500 cubic centimeters concentrated sulphuric acid, a solution of sodium hydrate containing 270 grams to the liter (sp. gr. 1.243), a one-fourth normal solution of sulphuric acid, a one-fourth normal solution of sodium hydrate, and some pulverized talcum or granulated zinc to prevent frothing or bumping. The procedure is as follows:—

Five or 10 cubic centimeters of urine, a measured quantity of feces in water, or about 40 cubic centimeters of the saline instillation in the performing of the Solomon test, are placed in the digesting flask and treated with 0.4 gram of mercuric chloride, well shaken, and then with 10 cubic centimeters of the sulphuric acid—phosphoric anhydride mixture. The digesting flask is then heated until the contents become clear and almost colorless. The flask should be inclined at an angle of about 45 degrees and vigorous boiling should be avoided. Toward the end of digestion, a few crystals of potassium permanaganate are added to insure complete oxidation.

Upon cooling, the contents of the flask are transferred to the retort, with the aid of a little distilled water, and slowly treated with the sodium hydrate solution in the proportion of 40 cubic centimeters for each 5 cubic centimeters of sulphuric acid. A little pulverized talcum or a few pieces of granulated zinc are added, the retort is connected with the distilling tube and the distillation begun. This is continued until two-thirds of the solution have passed over into the nitrogen bulb in which is carefully measured 30 cubic centimeters of the one-fourth normal solution of sulphuric acid. The condenser is washed clean and the washings added to the distillate. After the addition of a few drops of dimethylamidoazobenzol, the excess sulphuric acid is titrated with the one-fourth solution of sodium hydrate, and the amount found deducted from the 30 cubic centimeters used. The titration is carried on until the last trace of red has given way to a yellow. The difference multiplied by 0.0035 will indicate the amount of nitrogen present in the quantity of specimen examined; and in the case of urine, the amount of urea is found by multiplying this figure by 2.1.

The albumins which may be met with in urines are serum albumin, serum globulin, albumoses (peptones), and others. Of these, serum albumin and peptones are of the greatest clinical importance. Albuminuric urines are commonly met with in gastro-intestinal conditions. Leaving out of consideration the transitory, dietetic, or physiological (?) conditions in which albumin may be found in urines—severe muscular and mental labor, high indulgence in protein foods, cold baths, etc.—pathological albuminuria (constant presence) may be found in a number of medical conditions, among which are: nephritis, anemias, heart lesions, diabetes, pregnancy, arteriosclerosis, amyloid degeneration, the febrile diseases, neurotic disturbances, and so on. What concerns us particularly in this connection is digestive albuminuria, as well as that due to kidney changes in late digestive disease.

Excessive indulgence in eggs, cheese, beef, etc., may cause an albumin output in urines. While such may be considered physiological in a sense, the fact that it is so rarely observed in young healthy individuals inclines one to feel that its appearance has a pathological significance either in so far as the kidneys, the digestive tract, or the metabolic conditions of the general body are concerned. Evidences of organic kidney change (casts, blood, epithelium), however, should always be sought for, since in many of these instances such findings exist or will come on, and these point to a nephritis. In the absence of these, a daily output of 2 grams or more of albumin may be considered as positively pathological.

The rather constant appearance of albumin in small amounts is commonly met with in spasmodic conditions of the stomach, in cancer situated anywhere in the digestive canal, following excessive gastric hemorrhage, and in atrophic conditions of the gastro-enteric tract (such as chronic gastritis and gastro-enteric atrophy).

Albumoses are frequently encountered in urines in a number of the acute and chronic diseases. Of the various types of albumosuria described is the form present in resorption of albumoses from the disintegration of pus cells (pyogenic albumosuria); a form found in various diseases of the intestinal tract, such as typhoid, tuberculous ulceration, carcinoma, etc. (enterogenic albumosuria); a form noted in scurvy, dermatitis, poisonings, pregnancy, particularly following death of the fetus; carcinomatosis, etc. (hematogenic albumosuria); a form wherein the albumoses are derived from urinary albumins by the action of ferment or bacteria in the bladder (renal albumosuria); and an albumosuria seen when large quantities of albumin had been ingested (digestive albumosuria). As a rule, but very small quantities of albumose are met with, and unless it is isolated and examined for definitely its presence would be overlooked. The quantity is usually too small to be demonstrated by the direct application of the biuret test to the urine. Albumosuria has been met with by Robitschek in two out of seven cases of gastric cancer, once in gastric ulcer, and once in cancer of the rectum. At the present time, a diagnostic significance cannot be assigned to the condition, and its occurrence is most probably due to an anomaly of metabolism. The albumoses and peptones, while different in chemical characteristics, may in this connection be considered as an expression of an identical condition.

Ferments may be demonstrated in every urine, both normal and pathological. Because of the variability in which these are found, examinations for them are of no significance in diagnosis. It has been

in hypermotility, where the gastric carbohydrate conversion is low or when much carbohydrate has been ingested and is fermenting in the intestinal tract, the output of volatile fatty acids is increased. Lipaciduria may also be found in gastric cancer, but it is not of any special significance in that connection. For the reason that lipaciduria may be found in the two extremes of HCl secretion (high, or absent or low as in cancer), no practical value can be attached to the condition.

Oxalic acid is found in normal urines as a product derived from ingested foods and also the metabolism of the body. Under pathological conditions in the digestive canal, the oxalic acid may be formed as a fermentation product from the ingested carbohydrates. The amount normally eliminated in twenty-four hours fluctuates with the amount of vegetable foods partaken, and is usually less than 10 milligrams (Baldwin). An increased elimination is observed, notably in digestive and neurasthenic conditions, usually when the hydrochloric acid secretion is high (oxaluria). It is also observed in obesity and in stenotic conditions of the bile passages. Oxalic acid occurs in the urine as calcium oxalate, part of which is held in solution by the diacid sodium phosphate.

For the purpose of quantitatively estimating oxalic acid in urine the use of the Dunlap-Baldwin method is advised. To this end 50 cubic centimeters of mixed urine are thymolized, acidified (if alkaline with acetic acid, and 150 cubic centimeters of over 90 per cent. alcohol added to precipitate the calcium oxalate. The mixture is allowed to stand for forty-eight hours, filtered (water used to aid in obtaining all of the crystals from the container), and the sediment on the filter paper thoroughly washed with hot and cold water and finally with a 1-per-cent. solution of acetic acid. The filter is then placed in a small beaker and soaked in a small amount of dilute hydrochloric acid, and then washed with hot water until the washings no longer give an acid reaction to litmus paper. The acid solution and washings (combined) are filtered and evaporated on a water bath to about 20 cubic centimeters. This is treated with a very small amount of calcium chloride solution (to ensure the presence of an excess of calcium), the solution is neutralized with ammonia, slightly acidified with acetic acid, and treated with strong alcohol to 50 per cent. (so that the mixture contains 50 per cent. of alcohol). After forty-eight hours, the sediment is collected in a filter (mineral ash free), and washed with cold water and dilute acetic acid until free from chlorides. The filter and its sediment are then incinerated over a Bunsen burner, and afterward with a blow-pipe flame for a few moments. On cooling

## AUTHOR'S BLANK FOR COMPLETE URANALYSIS.

PHYSICAL		Per Cent. of Average	Average Men	Average Women
Collected during (hrs.)				
Quantity (c. c.)			969	978
Color			Amber	Amber
Deposit			0	0
Odor			Urinous	Urinous
Specific Gravity			1016	1015
Total Solids (gm)			34.19	27.46
Freezing Point			-1.31°	-1.15°
Urinary Depuration			4.175	4.200
<hr/>				
CHEMICAL				
Ac. Terms H <sub>2</sub> PO <sub>4</sub> (gm)			1.00	.79
Total Nitrogen (gm)			7.43	5.40
Urea (gm)			13.29	9.88
Uric Acid (gm)			.332	.308
Ammonia (gm)			.300	.295
Creatinin (gm)			.96	.63
Chlorides (gm)			6.89	6.93
Phosphates (gm)			1.75	1.17
Fixed Sulphates (gm SO <sub>3</sub> )			1.113	.776
Ethereal Sulphates (gm SO <sub>3</sub> )			.132	.106
Neutral Sulphur (gm SO <sub>3</sub> )			.186	.200
Sugar (gm)			0	0
Sugar (Phenylhyd. Test)			0	0
Diacetic Acid			0	0
Acetone			0	0
Albumin (% Vol.)			0	0
Albumin (gm)			0	0
Bile			0	0
Indican			0	0
Indolacetic Acid			0	0
Diazo Reaction			0	0

## MICROSCOPICAL

ORGANIC	CHEMICAL
Casts (No. in field)	Amorphous Urates
Pus Cells (No. in field)	Uric Acid Crystals
Blood Cells (No. in field)	Calc. Oxal. Crystals
Spermatozoa (No. in field)	Amorphous Phosphates
Epithelia Mucus	Triple Phos. Crystals
Bacteria Yeast Cells	Other Crystals

Date ..... 192 .....

over sulphuric acid the ash is weighed; the result multiplied by 1.6 represents the amount of oxalic acid present in the volume of urine examined. The great drawback to the Dunlap-Baldwin method is the amount of laboratory work required and the time it takes for the estimations. A much quicker and simpler one and one which answers sufficiently for clinical work is that employed by E. E. Smith. For this test 5 cubic centimeters of filtered urine, or the supernatant clear urine (after standing for several hours to allow sedimentation), is placed in a conical end test-tube and 5 cubic centimeters of alcohol are added. These are thoroughly mixed and the tube is left standing for two hours or centrifuged at once. The oxalate sediment is then withdrawn by means of a small-calibered pipette, and examined microscopically by means of a medium power. Normal urines contain no or very few crystals; a moderate increase, a noticeable number of crystals (about 20 to the field); a large increase, a great number in the field (sometimes as many as 50).

The examination of the sediment of urines possesses no specific direct significance in so far as the diagnosis of primary digestive disorders are concerned, and thus will not be included.

The author offers the contained blank which answers well for complete uranalysis.

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## CHAPTER X.

### Therapeutics.

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#### THE DIET.

It is evident that for whatever condition of illness special dieting may be employed, there is one fact that must always be observed, and that is, that food enough and of a practical degree of mixture must be given to properly maintain the physiological processes of life at their proper standard of efficiency. This is made possible by the supplying to the blood and tissues sufficient protein, carbohydrate, fat, water, and inorganic elements, so that the processes of activity in heat energy and organ functions can go on without the body tissues suffering materially thereby. Of course, the source of this is from the foods that we partake of, and in the construction of any dietary, whatever the local gastro-enteric condition may be, we must be careful that there is contained enough metabolic foundation for proper nutrition.

In this light, it is best to view the subject of dieting in a double way. Firstly, what is the approximate amount of food that, digested (allowing for the inevitable loss), absorbed, and oxidized, will maintain the nitrogen and carbon equilibrium in the person; and secondly, how can we modify the character of foods to meet the abnormal conditions present in the alimentary canal and still fully maintain the first indication mentioned?

In health it is a comparatively safe rule to follow, that providing the person partakes of a varied diet of the generally accepted foods of value, his supply, in so far as their quantities and character are concerned, can depend on his desires for them. Such animal and vegetable foods should be taken in the quantities which are best adapted to the amount of work that the individual performs. With all that has been said and written about the errors of our present-day plan of feeding in defence or in the advocacy of unique dietary régimes (like vegetarianism or the preponderating use of animal foods), in the main, the time-honored custom of a mixed diet insures the greatest amount of health and strength, although with many individuals some minor errors may exist in it. It may be said in a general way, that

among most people the main error consists, not so much in the character of foods that they eat, but in the quantities that are taken. That this is commonly too high can easily be proven by a computation of the total caloric values of the foods, and comparing this to the average weight, and amount of work that the individual ordinarily or at any special time performs. The study of the putrefactive changes in the gut, and the most probable cause of the establishment of many diseased conditions of the body, such as uremia, gout, obesity, chronic rheumatisms, disease of the intima of the arteries, chronic interstitial nephritis, chronic myocarditis, functional and organic diseases of the nervous system, diabetes, etc., shows this to be true. But that a continuous diet of Chittenden's low standard of protein per day is always necessary to prevent these I have my doubts. Still, the safest rule to follow is to first regard quantity and then the quality of food—is giving the normal person a somewhat loose range in the selection.

But when we are dealing with illness of the human body we must be more definite, and this means arranging dietaries to meet the prevalent conditions or to guard against these conditions becoming worse. In the maze of the various important sides to the question unless we have some standards to go by, we cannot hope to do full justice to the condition of our patient. What are the units of the standard of diet in illness?—the caloric value of foods, and all clinical dietaries can easily be built primarily on these points. The potential energy of the body is always well maintained when these are kept high enough.

As was stated before, from the physical standpoint, in disease as well as in health, the two main indications to be kept in view are the maintenance of the body heat without depriving the tissues of their component structure, and the supplying of enough food energy to meet the demands that are made upon the body in manual or mental work (potential energy). It must also be remembered that in the cold climates and severe seasons, the metabolism of the body is increased and thus more calories must be added to meet this extra demand.

Roughly speaking, an average adult man forms in his body and gives off to the surrounding air about 2,400,000 calories of heat per day. By a calorie is meant the quantity of heat necessary to raise the temperature of one gram of water one degree Centigrade. This supply of nutrition in the body is derived from the physiological oxidation of the carbohydrate, fat, and protein material of the food. In the making up of dietaries for the sick in a general way 2,750,000 small calories are about right for a man of 140 pounds, or about 100,000 small calories for each 5 pounds of body weight. It is plain that under-

standing the conditions that are to be met by the varieties and quantities of food, their selection according to the caloric method of feeding is not only scientific and easy of application, but is also the most practical and safest of methods. For here we are dealing with a definite scale, like doses of medicine, which we can increase above the normal physiological amounts for the purpose of adding weight, energy, and heat, maintain the equilibrium, or decrease as we see it to be indicated. The author believes in calories, and has often proved the practical application and value of their use in the construction of dietaries for the sick.

It is plain that for the purpose of a definite start in the construction of dietaries some standard of total calories must be accepted as the proper amount of food components in health. Since Rupner's classical work with foods that were oxidized outside of the living body in the calorimeter, it has been established that the oxidization of foods in the body produces practically the same amounts of heat as the same food artificially oxidized. It must be remembered that a portion of the food is lost to the general body and comes away in the feces. This on a mixed diet may be reckoned as 10 per cent., and thus, to what is established as the proper total of calories represented in a diet list, this much more must be added.

It manifestly means more work and greater danger of errors in the computation of the total calories of a diet if we deal with figures in the millions. To simplify this, most of the analytical work that has been done employs, to represent the potential energy value of foods, the unit of gross calories. This unit represents the amount of heat necessary to raise one kilogram of water 1° C., and thus represents one thousand small calories. In the list of all of the used foods that follows, the caloric value expressed is in that of the large units; therefore, the scale for per diem feeding could be built upon the basis of five pounds of body weight as requiring 100 calories, instead of 1000 as would be required in the small calories.

The average quantities of foods required by a man weighing 140 pounds would thus be, according to Rubner:—

2303	at rest.
2445	slight manual work.
2868	medium manual work.
3362	hard manual work.

The above is not mentioned as a standard, because there is no one schedule that would properly fit all persons, even of the same weight and amount of work performed each day. In a rough way, it may be taken that for ordinary amounts of work between 2500 and 3300

calories would answer for a 140-pound individual, and on a feeding over that, at such a weight, it would be reasonable to expect a systemic improvement in nutrition, weight, and strength, if the body be normal.

After having established a diet which is being strictly lived up to by a patient, there is one practical means of observing its success, and that is by the frequent use of the scales in the first two weeks after beginning it and periodically after that if necessary. The subjective sensations of weakness, faintness, and hunger must not receive too much attention in the face of a constantly maintained or increasing weight, good quality of pulse and general appearance of the individual. Many patients habitually overfeed themselves, and when this extra amount of food has been deprived them they are affected by it temporarily. After a short time; if the conditions continue favorable, these symptoms pass away and the patient usually ceases complaining.

Because of the compensatory functions of different parts of the alimentary canal to the different foods, it is not wise or conducive to the best results to build up the diet list on the times that the various foods leave the stomach. This phase of the subject of nutrition only comes under consideration, when, for any abnormal condition present, we must reckon on the relief of the local symptoms or condition. But when the physician's desires are mainly for a better nutrition of the general body, it is safe to take advantage of the fact that complete digestion in the small intestine can make up for any shortage of enzymatic power that may be existing in the gastric juice or saliva.

The following list of the compositions of foods and their values is compiled from Atwater and Woods, 1896, U. S. Dept. of Agriculture. Allowance is made for the products of metabolism of protein compounds which are not consumed in the body, but lost in the feces.

#### COMPOSITION OF FOODS.

FOOD MATERIALS	REFUSE	WATER	PROTEIN	FAT	CARBO-HYDRATES	ASH	FOOD VALUE PER POUND
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Calories
<b>BEEF, FRESH</b>							
Brisket, ave. age as purchased.....	14.3	40.6	12.5	31.9	.....	.7	1590
Chuck, including shoulder.....	19.9	54.1	15.3	9.9	.....	.8	785
Chuck, ribs.....	13.3	50.1	15.0	20.8	.....	.8	1135
Flank.....	33.8	54.4	16.7	24.3	.....	.8	1355
Loin.....	12.6	53.3	15.9	17.3	.....	.9	1025
Loin, boneless strip.....	.....	60.7	18.9	19.5	.....	.9	1175
Loin, sirloin, butt.....	.....	50.2	15.6	24.4	.....	.8	1320
Loin, top of sirloin.....	33.2	40.9	12.9	42.3	.....	.7	2025
Loin, trimmings.....	48.8	27.9	8.2	14.7	.....	.4	775

## THE DIET.

### COMPOSITION OF FOODS.—Continued.

FOOD MATERIALS	REFUSE	WATER	PROTEIN	FAT	CARBO-HYDRATES	ASH
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
<b>BEEF, FRESH</b>						
Navel.....	11.4	42.2	13.4	32.3	.....	.7
Neck.....	28.4	45.3	13.9	10.7	.....	.7
Plate.....	16.7	46.0	12.7	43.9	.....	.7
Ribs.....	20.2	44.9	13.6	20.6	.....	.7
Rib rolls.....	64.8	18.7	15.6	.....	.....	.5
Rib trimmings.....	34.1	35.7	10.5	19.2	.....	1.7
Rib, cross.....	12.5	48.0	14.1	24.7	.....	1.0
Round.....	8.5	63.0	18.7	8.8	.....	.8
Round, second cut.....	32.1	47.2	14.0	5.8	.....	.9
Rump.....	18.5	47.3	14.4	19.0	.....	.6
Shank, fore.....	36.5	44.1	13.1	5.7	.....	1.4
Shank, hind.....	54.8	31.3	9.2	4.3	.....	.6
Shoulder, clod.....	14.6	57.9	16.8	9.7	.....	1.0
Socket.....	35.8	36.7	10.7	16.2	.....	.6
Forequarter.....	19.8	49.3	14.1	16.1	.....	.7
Round, average as purchased.....	8.5	63.0	18.7	8.8	.....	1.0
Round, second cut.....	32.1	47.2	14.0	5.8	.....	.9
Rump.....	18.5	47.3	14.4	19.0	.....	.8
Shank, fore.....	36.5	44.1	13.1	5.7	.....	.6
Shank, hind.....	54.8	31.3	9.2	4.3	.....	1.4
Shoulder, clod.....	14.6	57.9	16.8	9.7	.....	1.0
Socket.....	35.8	36.7	10.7	16.2	.....	.7
Forequarter.....	19.8	49.3	14.1	16.1	.....	.8
Hindquarter.....	16.3	52.0	15.3	15.6	.....	.7
Side.....	18.3	50.4	14.6	16.0	.....	1.2
Hearts.....	.....	62.6	16.0	20.4	.....	1.0
Kidneys.....	.....	76.7	16.9	4.8	.....	1.2
Liver.....	.....	69.8	21.6	5.4	1.8	1.4
Lungs.....	.....	79.7	16.1	3.2	.....	1.0
Sweetbreads.....	.....	70.9	15.4	12.1	.....	1.6
Tongue.....	15.1	53.9	14.8	15.3	.....	.9
Beef, cooked sandwich meats.....	.....	58.3	37.9	11.0	.....	2.8
<b>BEEF, CANNED</b>						
Boiled.....	51.8	24.4	22.5	.....	.....	1.3
Ox, cheek.....	66.1	22.3	8.4	.....	.....	3.2
Chili, con carne.....	75.4	13.3	4.6	4.0	.....	2.7
Colllops, minced.....	72.3	17.9	6.8	1.1	.....	1.9
Corned, cooked.....	51.2	25.9	18.9	.....	.....	4.0
Dry, cooked as purchased.....	44.8	38.6	5.4	.....	.....	11.2
Kidney, stewed.....	71.9	18.4	5.1	2.1	.....	2.5
Luncheon.....	52.9	26.4	15.9	.....	.....	4.8
Ox palate.....	71.4	17.4	10.0	.....	.....	1.2
Roast.....	58.9	25.0	14.8	.....	.....	1.3
Steak, rump.....	56.3	23.5	18.7	.....	.....	1.5
Sweetbreads.....	69.0	19.5	9.5	.....	.....	2.0
Oxtails.....	67.9	24.6	6.3	.....	.....	1.2
Tongue, ground.....	49.9	21.0	25.1	.....	.....	4.0
Tongue, whole.....	51.3	21.5	23.2	.....	.....	4.0
Tripe.....	74.6	16.4	8.5	.....	.....	.5
<b>BEEF, CORNED AND PICKLED</b>						
Brisket, corned.....	21.4	40.0	14.7	19.4	.....	4.5
Beef, corned.....	9.4	49.6	14.2	22.8	.....	4.0
Extra mess.....	10.4	33.1	10.6	42.3	.....	3.6
Flank, corned.....	12.1	43.0	12.4	29.2	.....	2.6
Mess.....	10.5	33.0	10.7	39.9	.....	3.9
Plate, corned.....	14.5	34.3	11.4	35.8	.....	4.0
Rump, corned.....	6.0	54.5	14.4	22.0	.....	3.1
Spiced and rolled.....	.....	30.0	11.8	51.4	.....	6.8
Tongue, pickled.....	6.0	53.9	11.6	19.2	.....	4.3
Tripe, pickled.....	.....	87.4	10.9	1.2	.3	.2
<b>BEEF, DRIED, ETC.</b>						
Dried and salted.....	30.7	46.8	5.6	.....	.....	16.9
Dried in sun.....	19.4	47.0	21.6	.....	.....	12.0
Dried, salted and smoked.....	50.8	31.8	6.8	.....	.6	10.0

## THERAPEUTICS.

## COMPOSITION OF FOODS.—Continued.

FOOD MATERIALS	REFUSE	WATER	PROTEIN	FAT	CARBO-HYDRATES	ASH	FOOD VALUE PER POUND
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Calories
<b>VEAL FRESH AS PURCHASED</b>							
Breast .....	21.4	53.1	15.1	9.6	.....	.8	685
Chuck .....	18.0	59.5	15.6	5.2	.....	.8	510
Flank .....	66.9	19.4	12.7	.....	.....	.0	885
Leg .....	10.5	65.0	18.5	5.0	.....	1.0	555
Leg, cutlets .....	4.0	65.6	20.0	9.5	.....	.9	775
Loin .....	18.6	56.2	15.9	8.4	.....	.9	650
Loin, with kidney .....	9.1	66.7	12.8	10.7	.....	.7	690
Neck .....	31.5	49.9	13.3	4.6	.....	.7	440
Rib .....	26.4	53.0	14.8	5.0	.....	.8	485
Rump .....	30.2	43.7	14.0	11.3	.....	.8	735
Shank, fore .....	40.4	44.1	11.8	3.1	.....	.6	555
Shank, hind .....	61.1	28.6	7.7	2.2	.....	.4	235
Shoulder and flank .....	24.3	49.7	14.9	10.2	.....	.9	710
Shoulder .....	16.6	57.2	16.6	8.7	.....	.9	675
Forequarter .....	24.5	54.2	14.6	6.0	.....	.7	525
Hindquarter .....	20.7	56.2	15.7	6.6	.....	.8	570
Side .....	22.6	53.2	13.1	6.3	.....	.8	545
Heart .....	.....	73.3	16.2	9.6	.....	1.0	705
Kidney .....	.....	74.7	16.6	7.4	.....	1.3	625
Liver .....	.....	13.1	20.4	5.3	.....	1.2	605
Lungs .....	.....	76.8	17.1	5.0	.....	1.1	530
<b>LAMB, FRESH</b>							
Breast .....	19.1	45.5	15.5	19.1	.....	.8	1085
Leg, hind .....	13.8	50.3	15.3	19.7	.....	.9	1115
Loin, without kidney and tallow .....	14.8	45.3	15.1	24.1	.....	.8	1295
Neck, as purchased .....	17.7	46.7	14.4	20.4	.....	.8	1130
Shoulder .....	20.3	41.3	14.0	23.6	.....	.8	1235
Forequarter .....	18.8	44.7	14.7	21.0	.....	.8	1160
Hindquarter .....	15.7	51.3	16.0	16.1	.....	.9	975
Side, without kidney and tallow .....	19.3	47.0	14.2	18.7	.....	.8	1055
<b>LAMB, CANNED</b>							
Tongue .....	2.6	65.7	13.9	17.3	.....	.5	990
Ham, devilled .....	.....	45.3	18.9	32.9	.....	2.9	1740
Shoulder, fresh .....	32.5	35.9	10.4	20.7	.....	.5	1065
Shoulder, smoked .....	18.9	30.7	12.4	33.0	.....	5.0	1625
<b>PORK, SALTED AND PICKLED</b>							
Dry and salted backs .....	8.1	15.9	6.5	66.8	.....	2.7	2940
Dry and salted belly .....	8.2	16.2	6.2	66.2	.....	3.2	2910
Salt pork, lean ends .....	11.2	17.6	6.6	59.6	.....	5.1	2635
Tongue .....	3.2	56.8	17.5	19.1	.....	3.4	1130
Feet .....	33.5	44.6	10.0	9.3	.....	.6	580
Bacon, smoked .....	8.1	17.8	9.6	60.2	.....	4.3	2720
Pork, side .....	11.2	26.1	7.5	54.8	.....	.4	2455
<b>PORK, CANNED</b>							
Head .....	.....	60.1	17.8	19.3	.....	2.8	1145
<b>SAUSAGE</b>							
Arles .....	5.2	16.3	23.6	48.0	.....	6.9	2465
Banquet .....	1.6	61.7	17.7	15.4	.....	3.6	980
Bologna .....	3.3	55.2	18.0	19.7	.....	3.8	1165
Tongue .....	.....	47.6	23.6	24.0	.....	4.8	1450
<b>PORK</b>							
Chuck, ribs and shoulder .....	18.1	41.8	13.8	25.5	.....	.8	1335
Flank, cut .....	71.2	17.0	5.1	6.4	.....	.3	365
Head .....	68.4	13.7	3.8	13.9	.....	2.2	655
Headcheese .....	12.1	42.3	18.6	24.0	.....	3.0	1360
Loin .....	16.0	42.3	13.5	27.5	.....	.7	1410
Middle cuts .....	71.2	13.8	4.2	10.6	.....	.2	525
Shoulder cuts .....	59.6	19.1	5.3	15.7	.....	.3	760
Tenderloin .....	.....	65.1	19.5	14.4	.....	1.1	970

## COMPOSITION OF FOODS.—Continued.

FOOD MATERIALS	REFUSE	WATER	PROTEIN	FAT	CARBO-HYDRATES	ASH	FOOD VALUE PER POUND
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Calories
<b>PORK, HAM AND SHOULDER</b>							
Ham, fresh .....	42.4	35.7	10.7	10.6	.....	.6	645
Ham, smoked .....	12.7	35.9	14.1	33.2	.....	4.1	1665
Boiled, no bone .....	39.2	18.2	37.0	.....	.....	5.6	1900
Ham, boneless, raw .....	50.1	15.4	28.5	.....	.....	6.0	1490
Ham, luncheon, boneless..	49.2	24.0	21.0	.....	.....	5.8	1320
<b>MUTTON, FRESH</b>							
Chuck .....	19.4	37.0	11.1	31.8	.....	.7	1550
Flank .....	42.0	13.9	43.4	.....	.....	.7	2090
Leg, hind .....	17.4	52.2	15.1	14.5	.....	.8	875
Loin, without kidney and tallow .....	14.2	40.5	12.8	31.9	.....	.6	1585
Neck .....	27.2	41.0	11.7	19.4	.....	.7	1035
Shoulder .....	21.5	47.0	13.4	17.4	.....	.7	985
Forequarter .....	21.1	40.6	11.9	25.7	.....	.7	1305
Hind, without tallow and kidney .....	16.7	45.6	13.5	23.5	.....	.7	1245
Heart, as purchased .....	69.5	17.0	12.6	.....	.....	.9	845
Kidney .....	78.7	16.8	3.2	.....	.....	1.3	450
Liver .....	61.2	23.1	9.0	5.0	.....	1.7	900
Lungs .....	75.9	20.1	2.8	.....	.....	1.2	490
<b>MUTTON, CANNED</b>							
Corned .....	45.8	27.2	22.8	.....	.....	4.2	1470
Farmer .....	3.9	22.2	26.2	40.4	.....	7.3	2175
Frankfort .....	55.5	21.7	18.8	.....	.....	3.6	1205
Holstein .....	2.2	35.6	28.7	36.5	3.3	4.2	2135
Lyons .....	10.0	29.2	29.1	24.5	.....	7.2	1575
Pork .....	38.7	12.8	45.4	.....	.....	2.3	2170
Pork, sausage meat .....	46.2	17.9	32.5	.....	.....	3.4	1705
Summer .....	7.0	20.9	23.0	42.1	.....	7.0	2220
Tongue .....	46.4	17.3	33.1	.....	.....	3.2	1720
<b>POULTRY AND GAME, FRESH</b>							
Chicken .....	34.8	58.5	14.8	1.1	.....	.8	325
Fowl .....	30.1	45.6	13.4	10.2	.....	.8	680
Goose .....	22.2	33.1	10.3	33.8	.....	.6	1620
Turkey .....	22.7	42.4	15.7	18.4	.....	.8	1070
<b>FISH</b>							
Black bass .....	54.8	34.6	9.3	.8	.....	.5	205
Sea bass .....	56.1	34.8	8.3	.2	.....	.6	160
Striped bass .....	55.0	35.1	8.3	1.1	.....	.5	200
Bluefish .....	48.6	40.3	9.8	.6	.....	.7	205
Batterfish .....	42.8	40.1	10.2	6.3	.....	.6	445
Cod, dressed .....	29.9	58.5	10.6	.2	.....	.8	205
Eels .....	20.2	57.2	14.6	7.2	.....	.8	575
Flounders .....	57.0	35.8	6.3	.3	.....	.6	130
Haddock .....	51.0	40.0	8.2	.2	.....	.6	160
Halibut .....	17.7	61.9	15.1	4.4	.....	.9	465
Herring .....	62.6	41.7	10.9	3.9	.....	.9	370
Kingfish .....	56.6	34.4	8.1	.4	.....	.5	170
Mackerel .....	40.7	43.7	11.4	3.5	.....	.7	360
Perch, white .....	62.5	28.4	7.2	1.5	.....	.4	195
Pickercel .....	42.7	45.7	10.7	.3	.....	.6	210
Pompano .....	45.5	39.5	10.2	4.3	.....	.5	370
Porgie .....	60.0	29.9	7.4	2.1	.....	.6	225
Red snapper .....	45.3	43.7	10.0	.3	.....	.7	200
Salmon .....	29.5	48.1	13.5	8.1	.....	.8	590
Shad .....	50.1	35.2	9.2	4.8	.....	.7	375
Shad roe .....	71.2	20.9	3.8	2.6	1.5	600	600
Sheepshead .....	56.5	31.3	8.8	2.9	.....	.5	285
Smelt .....	41.9	46.1	10.0	1.0	.....	1.0	230
Trout, brook .....	48.1	40.4	9.8	1.1	.....	.6	230
Tomcod .....	59.9	32.7	6.8	.2	.....	.4	135
Weakfish .....	51.9	38.0	8.4	1.1	.....	.6	200
Whitefish .....	53.5	32.5	10.3	3.0	.....	.7	325

## COMPOSITION OF FOODS.—Continued.

FOOD MATERIALS	REFUSE	WATER	PROTEIN	FAT	CARBO-HYDRATES	ASH	FOOD VALUE PER POUND
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Calories
<b>SHELLFISH, ETC.</b>							
Clams, round.....	80.8	10.6	1.1	5.2	2.3	340	
Crabs, hard.....	52.4	36.7	7.9	.9	.6	1.5	195
Lobster.....	61.7	30.7	5.9	.7	.2	.8	145
Mussels.....	46.7	44.9	4.6	.6	2.2	1.0	150
Oysters.....	88.3	6.1	1.4	3.3	.9	.9	235
Scallops.....	80.3	14.8	.1	3.4	1.4	345	
Eggs, hen's.....	73.5	14.9	10.6	.....	1.0	725	
<b>DAIRY PRODUCTS, ETC.</b>							
Butter.....	87.1	3.3	4.0	5.0	.7	4750	
Whole milk.....	90.5	3.4	.3	5.1	.7	325	
Skim milk.....	91.0	3.0	.5	4.8	.7	170	
Buttermilk.....	30.5	8.2	7.1	52.3	1.9	1425	
Condensed milk.....	74.0	2.5	18.5	4.5	.5	910	
<b>CHEESE</b>							
American, pale.....	31.6	28.6	36.2	.....	3.4	2060	
American, red.....	28.6	29.6	38.3	.....	3.5	2165	
Bondi.....	55.2	15.4	21.7	.7	7.0	1215	
Cheddar.....	35.6	28.2	32.0	.....	4.2	1875	
Cheshire.....	37.1	26.9	31.6	.....	4.4	1835	
Crown Brand.....	35.2	5.2	58.0	2.2	3.2	2585	
Dutch.....	60.2	37.1	17.7	.....	10.0	1435	
Brie.....	20.7	15.9	21.0	1.4	1.5	1210	
Imitation Old English.....	42.1	30.1	52.7	1.3	5.2	2385	
Limburger.....	.....	23.0	29.4	1.4	5.1	1675	
Neufchatel.....	50.0	18.7	27.4	1.5	2.4	1530	
Pineapple.....	23.0	29.9	38.9	2.6	5.6	2245	
Roquefort.....	39.3	22.6	29.5	1.8	6.8	1700	
Swiss.....	31.4	27.6	34.9	1.3	4.8	2010	
Whole milk.....	33.7	26.0	34.2	2.3	3.8	1965	
Partly skimmed.....	38.2	25.4	29.5	3.6	33.3	1785	
Skim milk.....	45.7	31.5	16.4	2.2	4.2	1320	
<b>MISCELLANEOUS</b>							
Gelatin.....	13.6	84.2	.1	.....	2.1	1570	
Mincemeat, commercial.....	27.7	6.7	1.4	60.2	4.0	1305	
Mincemeat, home-made.....	56.8	4.0	6.1	31.3	1.8	915	
Tallow, refined.....	.....	.....	10.0	.....	.....	4220	
Lard, refined.....	.....	.....	100.0	.....	.....	4200	
Cottolene.....	.....	.....	100.0	.....	.....	4200	
Oleomargarine.....	9.3	1.3	82.7	.....	6.7	3515	
<b>VEGETABLE FOOD—WHEAT, FLOUR, MEALS, ETC.</b>							
California fine flour.....	13.8	7.9	1.4	76.4	.5	1625	
Entire wheat.....	12.1	14.2	1.9	70.6	1.2	1660	
Graham.....	11.8	13.7	2.2	70.3	2.0	1655	
Low grade.....	11.4	13.9	2.6	70.8	1.3	1685	
Koller process.....	12.5	11.3	11.1	74.6	.5	1645	
Spring wheat.....	11.6	11.8	1.1	75.0	.5	1660	
Winter wheat.....	12.5	10.4	1.0	75.6	.5	1640	
Unclassified.....	12.3	10.7	1.1	75.4	.5	1650	
Prepared.....	10.8	10.1	1.2	74.3	3.6	1620	
Crushed wheat.....	10.5	11.9	1.7	74.5	1.4	1680	
Macaroni and vermicelli.....	10.8	11.7	1.6	72.9	3.0	1640	
White wheat farina.....	9.7	11.1	1.4	77.6	.2	1710	
<b>OTHER FLOURS, MEALS, ETC.</b>							
Barley meal.....	11.9	10.5	2.2	72.8	2.6	1640	
Harley, pearlized.....	10.8	9.3	1.0	77.6	1.3	1660	
Buckwheat flour.....	14.3	6.1	1.0	77.2	1.4	1590	
Cornmeal, bolted.....	12.9	8.9	2.2	75.1	.9	1635	
" unbolted.....	1.5	10.2	7.3	66.7	1.2	1550	
Corn, hominy.....	11.9	8.2	.6	78.9	.4	1645	
Corn, pop, popped.....	4.3	10.7	5.0	78.7	1.3	1675	

## COMPOSITION OF FOODS.—Continued.

FOOD MATERIALS	REFUSE	WATER	PROTEIN	FAT	CARBO-HYDRATES	ASH	FOOD VALUE PER POUND
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Calories
<b>OTHER FLOURS, MEALS, ETC. (continued).</b>							
Oatmeal.....	7.2	15.6	7.3	68.0	1.9	1860	
Oats, rolled.....	7.2	16.9	7.2	66.8	1.9	1860	
Rice.....	12.4	7.8	.4	79.0	.4	1630	
Rice, boiled.....	52.7	5.0	.1	41.9	.3	875	
Rice, flour.....	9.1	9.1	7.4	65.9	8.5	1705	
Rye meal or flour.....	12.7	7.1	.9	78.5	.8	1630	
<b>BREAD, CRACKERS OR PASTRY</b>							
Bread, white.....	35.4	9.5	1.2	52.8	1.1	1205	
Bread, brown.....	40.0	5.0	2.4	50.7	1.9	1135	
Corn, Johnny cake.....	38.0	8.5	2.7	47.3	3.5	1150	
Cassava.....	10.5	9.1	.3	79.0	1.1	1650	
Ghuten.....	33.7	11.1	2.4	47.6	2.2	1210	
Graham.....	32.3	8.5	1.8	55.9	1.5	1275	
Rye.....	31.8	10.1	.7	55.9	1.5	1255	
Rye and wheat.....	35.3	11.9	.3	51.5	1.0	1190	
Rolls, milk.....	26.7	8.5	9.6	54.4	.8	1575	
" water.....	32.6	9.1	3.0	54.1	1.2	1300	
" wheat, white.....	23.3	10.2	5.2	60.4	.9	1530	
Biscuit.....	22.9	9.3	13.7	52.6	1.5	1730	
Buns, cinnamon.....	23.6	9.4	7.2	59.1	.7	1570	
" hot cross.....	36.7	7.9	4.8	59.7	.9	1275	
" sugar.....	30.1	8.0	8.1	51.9	1.0	1455	
Cake, baker's.....	23.3	4.6	5.9	60.5	.7	1460	
" coffee.....	30.1	8.6	6.6	53.9	.8	1600	
" cup.....	16.3	6.6	2.5	73.8	.8	1600	
" drop.....	16.6	7.6	14.7	60.3	.8	1880	
" frosted.....	17.7	6.2	9.4	64.3	2.4	1705	
" fruit.....	16.9	6.2	10.5	64.7	1.7	1760	
" gingerbread.....	16.1	5.4	9.5	64.7	4.3	1705	
" marble.....	18.5	7.1	9.3	63.9	1.2	1715	
" sponge.....	11.6	6.5	9.6	70.3	2.2	1830	
Crackers, Boston.....	8.2	10.7	9.9	68.8	2.4	1895	
" butter.....	6.9	9.2	13.6	69.4	.9	2035	
" cream or milk.....	7.0	9.3	13.1	69.2	1.4	2010	
" graham.....	5.0	9.8	13.6	69.7	1.9	2050	
" oatmeal.....	4.9	10.4	13.7	69.6	1.4	2065	
" oyster.....	4.3	11.0	8.8	74.2	1.7	1955	
" pilot bread.....	7.9	12.4	4.4	74.2	1.1	1795	
" soda.....	8.0	10.3	9.4	70.5	1.8	1900	
Doughnuts.....	17.9	6.6	21.9	52.6	1.0	2025	
Jumbies.....	24.8	7.3	15.7	51.9	1.3	1745	
Pie, apple.....	43.2	3.3	9.8	41.7	2.0	1250	
" cream.....	29.4	6.3	8.1	54.9	1.3	1480	
" lemon.....	47.4	3.6	10.1	37.4	1.5	1190	
" mince.....	42.6	6.5	12.1	37.2	1.6	1325	
" squash.....	64.2	4.4	8.4	21.7	1.3	840	
Pudding, tapioca.....	61.8	3.6	3.7	30.0	.9	780	
Wafers, vanilla.....	5.8	6.8	15.7	71.2	.5	2115	
<b>SUGARS</b>							
Honey, strained.....	25.7	2.7	.....	75.1	.....	1395	
Molasses.....	25.7	2.7	.....	78.0	3.6	1315	
Sugar, granulated.....	.....	.....	.....	100.0	.....	1860	
" maple.....	.....	.....	.....	82.8	.....	1540	
Syrup.....	.....	.....	.....	70.1	.....	1305	
<b>STARCHES</b>							
Tapioca.....	11.6	.4	.3	87.5	.2	1650	
Starch.....	.....	.....	.....	78.0	.....	1825	
<b>VEGETABLES</b>							
Artichokes.....	79.5	2.6	.2	16.7	1.0	365	
Asparagus.....	94.0	1.8	.2	3.3	.7	105	
Beans, dried.....	13.2	22.3	1.8	59.1	3.6	1590	
" lima.....	11.1	15.9	1.8	67.1	4.1	1620	

## THERAPEUTICS.

### COMPOSITION OF FOODS.—Continued.

FOOD MATERIALS	REFUSE	WATER	PROTEIN	FAT	CARBO-HYDRATES	ASH	FOOD VALUE PER POUND
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Calories
<b>VEGETABLES (continued).</b>							
Beans, green .....	68.5	7.1	.7	22.0	1.7	570	
" string.....	87.3	2.2	.4	9.4	.7	235	
Beets .....	20.0	70.0	1.3	1.1	7.7	.9	170
Brussels sprouts .....	15.0	75.0	4.0	2.9	3.7	1.4	180
Cabbage.....	15.0	76.8	1.8	1.3	4.9	1.2	140
Carrots .....	20.0	70.5	.9	1.3	7.4	.9	170
Cauliflower head.....	90.8	1.6	.8	6.0	.8	175	
Celery.....	94.4	1.4	.1	3.0	1.1	.85	
Corn, green.....	81.3	2.8	1.1	14.1	.7	360	
Cucumbers.....	96.0	.8	.2	2.5	.5	70	
Eggplant.....	92.9	1.2	.3	5.1	.5	130	
Greens.....	82.9	3.8	.9	8.8	3.5	275	
Kohlrabi.....	92.1	2.0	.1	5.5	1.3	145	
Leeks .....	91.8	1.2	.5	5.8	.7	150	
Lentils.....	10.7	26.0	1.5	58.6	3.2	1635	
Lettuce .....	94.0	1.3	.4	3.3	1.0	165	
Okra .....	87.0	2.0	.4	9.5	.7	230	
Onions .....	87.3	1.7	.4	9.9	.7	235	
Parsnips .....	79.9	1.7	.6	16.1	1.7	335	
Peas, dried .....	10.8	24.1	1.1	61.5	2.5	1640	
" green.....	79.1	4.4	.5	16.1	.9	400	
" sugar, green.....	81.8	3.4	.4	13.7	.7	335	
Potatoes, boiled .....	73.7	2.7	.2	22.3	1.1	475	
" raw.....	78.9	2.1	.1	18.1	.9	360	
" sweet.....	69.3	1.8	.7	27.1	1.1	565	
Pumpkins .....	93.1	1.0	.1	5.2	.6	120	
Radishes .....	90.8	1.4	.1	6.6	1.1	155	
Rhubarb.....	94.4	.6	.7	3.6	.7	105	
Ruta-bagas.....	88.9	1.3	.2	8.5	1.1	190	
Sauerkraut .....	86.3	1.5	.8	4.4	7.0	145	
Spinach .....	92.4	2.1	.5	3.1	1.9	120	
Squash.....	86.5	1.6	.6	10.4	.9	245	
Tomatoes .....	94.4	.8	.4	3.9	.5	105	
Turnips .....	88.9	1.4	.2	8.7	.8	195	
<b>VEGETABLES, CANNED</b>							
Asparagus .....	94.4	1.5	.1	2.8	1.2	85	
Beans and pork, baked .....	68.0	6.9	3.3	37.7	2.1	685	
Beans, string.....	93.6	1.1	.1	3.9	1.3	95	
" French string.....	95.2	1.1	.1	2.5	1.1	70	
" lima.....	79.5	4.0	.3	14.6	1.6	360	
" shelled.....	72.7	7.0	.2	18.5	1.6	480	
Brussels sp.outs.....	93.7	1.5	.1	3.4	1.3	95	
Corn, green.....	75.7	2.8	1.3	19.3	.8	655	
Corn and tomatoes.....	87.6	1.6	.4	9.6	.8	225	
Okra .....	94.4	.7	.1	3.6	1.2	85	
Peas, green .....	85.3	3.6	.2	9.8	1.1	255	
Potatoes, sweet .....	55.2	1.9	.4	41.4	1.1	820	
Pumpkin .....	91.6	.8	.2	6.7	.7	15	
Squash.....	87.6	.9	.5	10.5	.5	235	
Tomatoes .....	94.0	1.2	.2	4.0	.6	105	
<b>FRUIT, BERRIES, ETC., FRESH</b>							
Apples .....	82.0	.5	.5	16.6	.4	340	
Apricots .....	85.0	1.1	.....	13.4	.5	270	
Bananas, yellow .....	74.1	1.2	.8	22.9	1.0	480	
Blackberries .....	88.9	.9	2.1	7.5	.6	245	
Cherries .....	96.1	1.1	.8	11.4	.6	265	
Citron melons, dried .....	25.6	.4	.6	72.5	.9	1380	
Cranberries .....	88.5	.5	.7	10.1	.2	225	
Figs, fresh .....	79.1	1.5	.....	18.8	.6	380	
Grapes .....	78.8	1.3	1.7	17.7	.5	455	
Lemons .....	89.3	1.1	.9	8.3	.5	210	
Muskmelons .....	89.5	.6	.....	9.3	.6	165	
Nectarines .....	82.9	.6	.....	15.9	.6	305	
Oranges .....	88.3	.8	.6	9.7	.6	220	
Pears .....	83.9	.6	.8	14.2	.5	310	

## COMPOSITION OF FOODS.—Concluded.

FOOD MATERIALS	REFUSE	WATER	PROTEIN	FAT	CARBO-HYDRATES	ASH	FOOD VALUE PER POUND
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Calories
<b>FRUIT, BERRIES, ETC., FRESH (continued).</b>							
Pineapples .....	89.3	.4	.3	9.7	.3	200	
Plums .....	78.4	1.0	.....	20.1	.5	390	
Prunes .....	80.2	.8	.....	18.5	.5	360	
Raspberries .....	85.8	1.0	.....	12.6	.6	255	
Strawberries .....	90.9	1.0	.7	6.8	.6	175	
Watermelons .....	92.9	.3	.1	6.5	.2	130	
Whortleberries .....	82.4	.7	3.0	13.5	.4	390	
<b>FRUIT, DRIED</b>							
Apples .....	35.2	1.4	3.0	57.6	1.8	1225	
Apricots .....	32.4	2.9	.....	63.3	1.4	1230	
Currants .....	27.9	1.2	3.0	65.7	2.2	1370	
Dates .....	20.8	2.2	5.1	70.4	1.5	1565	
Figs .....	22.5	5.1	.....	70.0	2.4	1395	
Grapes, ground .....	34.8	2.9	.6	60.5	1.2	1205	
Raisins .....	14.0	2.5	4.7	74.7	4.1	1635	
<b>FRUIT, CANNED</b>							
Apples, crab .....	42.4	.3	2.4	54.4	.5	1120	
Blackberries .....	40.0	.8	2.1	56.4	.7	1150	
Blueberries .....	85.3	.6	.7	13.0	.4	280	
Peaches .....	93.7	.5	.2	5.3	.3	115	
Pineapples .....	61.8	.4	.7	36.4	.7	715	
Chestnuts, fresh .....	38.5	6.9	8.0	44.9	1.7	1300	
Chestnuts, dried .....	5.8	10.6	10.0	70.9	2.7	1940	
Cocoanut .....	3.5	6.3	57.4	31.5	1.3	3125	
Peanuts .....	9.2	25.8	38.6	34.4	2.0	2560	
<b>MISCELLANEOUS</b>							
Chocolate .....	10.3	12.5	47.1	26.8	3.3	2720	
Cocoa .....	4.6	21.6	28.9	37.7	7.2	2320	

## AMOUNTS AND CHARACTER OF FOODS IN DIGESTIVE DISORDERS.

In the matter of the feeding for an ill person and the construction of a diet, we must take into consideration the increasing, lowering, or maintenance of his nutrition, supplying enough calories to the body to maintain his power of energy, and at the same time change the character and amounts of foods so as to properly meet the digestive powers, however disturbed they may be. Many times, when the general body is below the proper standard of nutrition or when other definite indications exist for specific food elements, for the time being at least, it would be wisest to disregard the changed condition of gastric digestion and keep one's attention generally on the nutrition of the body as a whole. Often many of the local conditions will make substantial improvement under this application. On the other hand, it must ever be remembered that local conditions may exist in the digestive tract, which, absolutely disregarded will result in little or no general improvement (because the foods are not fully or are improperly digested), and that

the local condition would be rendered subjectively worse by the accumulation of undigested foods from which added general as well as local harm may result. As examples of this may be mentioned the errors of gastric and small intestinal digestion causing low amounts of secretions in these organs (such as organic disease of the glandulation of the stomach, pancreas, and small intestine), where there is abundant toxogenic decomposition of the proteins and fats due to bacteria in the canal, or where the albumin loss of the whole food is constantly great. In the construction of the diet to meet abnormal conditions in the alimentary canal, the note must be sounded that should a mistake be made it might better be made on the side of too much food rather than being too strict in the curtailing of it. Attention is again drawn to the facts that the proteins may be markedly decreased and the quota of circulating proteins be maintained by the carbohydrates, and that these, under conditions of good starch digestion, can be considerably increased without causing local distress; and further, that the entire canal is compensatory in its digestive power to all distinct food substances.

#### THE GASTRIC RESPONSE TO FOODS.

Presenting in brief subject matter of the many gastric observations of foods made by Hawk, Rehfuss and their collaborators<sup>1</sup> the following possess some practical importance in the construction of diets for stomach conditions.

Milk drunk rapidly leaves the stomach sooner and produces a smaller curd mass than milk drunk slowly or sipped. Pure whole milk in the human stomach forms firm white curds which have a rubber-like characteristic. The maximum curd formation takes place about one hour after the milk has entered the stomach. Curds may be as large as a man's thumb and weigh at least 15 grams, which when boiled five minutes curdle in an entirely different manner. In this instance the curds are small, soft, flaky and of a yellow color. The largest curds are about the size of a small pea. These curds leave the stomach sooner and are much more digestible than the tough curds resulting from the ingestion of raw milk. Dietetically, therefore, boiled milk is to be preferred to the raw product. Particularly hard, tough curds of large size are formed in the human stomach after the entrance of raw skimmed milk. The curds form in about a half a minute and inside of five minutes they coalesce to form curds as large as a man's thumb. When skimmed milk is boiled, the resulting curds are not as large and tough as are those of the raw skimmed milk nor as small and soft as the curds of boiled whole milk.

Curds of boiled whole milk are digested more rapidly than are those of boiled skimmed milk. The addition of 2½ grams of sodium bicarbonate to 500 cubic centimeters of raw whole milk causes the formation of curds which are smaller and softer than those produced in similar milk in the absence of the bicarbonate. The addition of bicarbonate to whole milk does not produce as small soft curds as those met with in boiled whole milk without bicarbonate being added. The boiled milk leaves the stomach sooner than the bicarbonate milk. As a rule, the character of milk curds is influenced in a very direct way by the fat concentration. That is, the more fat, the less curd. In fact when 40 per cent. cream is drunk, no curds are formed during the first half hour and even then the largest curds are only about the size of the head of a pin. It is also found that milks of high fat concentration are very slow to leave the stomach. Pasteurization of milk is not nearly as effective as boiling in altering the type of curd formation because the curds from pasteurized milk are larger than those from boiled milk but not so large as those from raw whole milk.

Raw beef appears to be handled by the stomach with the same ease as beef that is cooked, whether rare, medium or well-done, although the rare beef has perhaps a slight advantage in this respect. Very tough steaks from the cheaper and tougher cuts of meat, such as rump and shank, are distinctly more rapidly evacuated than sirloin or the best tenderloin steak in the same individual. Roast beef is found to lie between these two classes of steaks in gastric response and evacuation time. Hamburg steak is found to leave the stomach in about the same time as an equal weight of roast beef under the same conditions. Stewed beef leaves the stomach in the same time as roast beef. The same may be said of boiled corned beef, dried beef and beef bologna. Calves' liver leaves the stomach in a slightly longer time and beef tongue is less readily digested than dried beef. The same may be said of tripe. The average evacuation time of 100 grams of beef products is two hours and thirty-five minutes in subjects of rapid emptying time and three hours and twenty-five minutes in subjects of slow emptying time. Total acidities as high as 184 are obtained on meats. The average total acidity at the height of digestion was in the case of beef products 120.

The average evacuation time for pork products is two and three-fourth hours. Subjects of the slow-emptying type show a general average of three hours and forty minutes. The average total acidity observed at the height of digestion is 117. This somewhat slow evacuation of the pork products is probably due to their high fat content. Pork is retained in the stomach longer than roast beef in most instances. Chops require the same period as roast pork and in the instance of fried ham

it is considerably longer than roast beef. Liver and bacon require about the same period of digestion as roast beef. The evacuation of bacon is slow and low gastric acidities are developed. Ham sandwiches are handled more readily than most other pork products.

Lamb is found to require two to three hours (average two and one-half hours) for individuals possessing the rapid-emptying type of stomach to digest, and from three to four hours (average three hours and twenty minutes) for individuals with the slow-emptying type of stomach. Roast lamb and lamb chops require practically the same period of gastric digestion, and stewed lamb a little longer than the other two. Sheep brains leave the stomach rather rapidly (two and one-half hours) and develop a lower acidity than the other meats. Lamb stimulates acid production fully as much as any other class of meats and apparently to a slightly greater extent than beef or pork. The average total acidity at the height of digestion was 134. On the average, roast lamb remains in the stomach a few minutes longer than roast beef but not as long as roast pork.

Eggs give rise to less stimulation of gastric secretion than meat and leave the stomach sooner. The average of the highest acidities developed in egg experiments was 80, and in general, eggs show high combined acidities throughout the early period of digestion. Raw egg white left the stomach much more rapidly than any other form of egg preparation. Egg white with 200 cubic centimeters of distilled water produced a more marked stimulation of acid secretion. Egg white with 200 cubic centimeters of orange juice leads to a distinct gastric secretion and a rapid evacuation of the stomach. Raw egg yolk takes much longer to leave the stomach than egg white and higher acidities are developed. Whole raw eggs resemble egg yolk in their response whether unmixed or strained through cloth, showing the same delayed evacuation and greater acid stimulation as compared with egg white. Raw eggs produce somewhat less stimulation of acid secretion than boiled eggs and remain longer in the stomach. Hard boiled eggs require on the average a few minutes longer for gastric digestion than soft boiled eggs but the acid responses are similar in the two cases. Scrambled eggs require a little longer to leave the stomach than boiled eggs. Fried eggs are handled as readily as soft boiled eggs or any other type of cooked egg. Eggs scrambled or fried with a large excess of fat remains in the stomach a little longer, the difference being most marked with the rapid-emptying type of individual. The responses of the stomach to plain and Spanish omelets are found to be quite similar. Omelet remains in the stomach as long as scrambled eggs and longer than boiled eggs. Poached eggs,

shirred eggs and soft cooked eggs are found to be among the more readily digested forms of eggs.

Eggs pickled in vinegar are digested in the same time as the hard boiled eggs from which they were prepared. Deviled eggs remain in the stomach a little longer than plain boiled eggs. Cold storage eggs, whether boiled or fried, can not be distinguished from fresh eggs as far as the response of the stomach is concerned. The same is true of the mixed frozen eggs of commerce, whether these are scrambled or used in the baking of cakes. Eggs with milk, or egg-nog, leave the stomach a little more slowly than eggs alone, the egg albumin preventing the formation of indigestible curds in the stomach such as are formed with milk alone. Eggs with bread or French toast remains in the stomach a little longer than bread and butter alone, but not longer than hard boiled eggs. Bacon and eggs are taken care of by the stomach almost as readily as fried eggs alone while possessing distinctly higher food value. Frizzled beef with scrambled eggs are digested as quickly as scrambled eggs alone. Eggs and meat appear therefore to form a desirable combination from the standpoint of gastric digestion.

A study was made of the response of the normal human stomach to thirty different kinds of vegetables prepared in different ways. The average evacuation time for all subjects of the rapid-emptying type was two hours and for the slow-emptying type two and one-half hours. The averages of the high points of the total acid curves were 70 and 77 respectively. The response of the stomach to potatoes prepared in the following different ways was determined: Whole boiled, creamed, mashed (with and without milk and butter), baked (with and without butter), potato salad, Grench, German and plain fried potatoes, and potato chips. All of these left the stomach in moderate time or one and one-half to two and one-half hours for rapid type individuals and two to three and one-half hours for the slow type. Baked potatoes with butter required more than the average time but plain baked potatoes about the same time as boiled potatoes. The addition of milk and butter to mashed potatoes had little effect nor did creamed potatoes or potato salad differ much from plain boiled potatoes as regards gastric response. Fried potatoes leaves the stomach as rapidly as potatoes prepared in other ways. French fried potatoes a few minutes longer than German or plain fried potatoes. Potato chips are handled very rapidly by the stomach considering their high solid and fat content. Sweet potatoes whether boiled, baked or fried remains longer in the stomach than white potatoes cooked in the same ways. Dasheens, whether boiled, baked or fried requires a longer period of gastric digestion than white potatoes but no longer than sweet potatoes. Boiled oyster plant took about the same

period of gastric digestion as white potatoes. Boiled red beets leave the stomach rapidly, i.e., in from one to two hours. After being pickled in vinegar they left still more rapidly, the vinegar evidently hastening the evacuation. Raw carrots also leave the stomach rapidly (in from one and one-half to two hours). Boiled carrots take distinctly longer (two and one-fourth to two and one-half hours).

Boiled parsnips require distinctly longer than beets or carrots. Boiled turnips leave the stomach in one and one-half hours. Radishes in amounts of 50 grams leave the stomach very rapidly (in from one and one-fourth to one and one-half hours). Baked beans from their high protein content remain longer in the stomach than most other kinds of vegetables and develop higher combined acidities. String beans, on the other hand, leave the stomach rapidly resembling more closely the green vegetables in stimulatory power upon the stomach. Boiled peas require one and three-fourths hours or less time than baked beans. Boiled lentils require a little longer than peas. Asparagus leaves the stomach rapidly. Boiled cauliflower requires only a few minutes longer. The same may be said of cabbage whether it be taken raw or cooked. Boiled cabbage is not handled by the stomach more readily than the raw. Cold slaw and sauerkraut require distinctly longer to leave the stomach than plain cabbage. Lettuce, in spite of its bulky character, is one of the most easily evacuated of foods, the response to this food resembling that to cabbage. The addition of sugar and vinegar or oil delayed evacuation. Celery in the raw state is evacuated more slowly than cabbage or lettuce but creamed celery causes less difficulty. Spinach remains in the stomach distinctly longer than most vegetables. Onions stewed and fried show slower evacuation than other vegetables low in protein. Cucumbers do not impose any special burden on the stomach, whether salted or unsalted. Boiled squash leaves the stomach in about the same time as boiled carrots or sugar corn. Raw tomatoes leave the stomach very rapidly, boiled tomatoes requiring a longer time. Mushrooms require only a moderate period of gastric digestion. Stewed corn leaves the stomach as rapidly as raw carrots or tomatoes and boiled hominy requires but little longer. Boiled unpolished rice and boiled barley are readily handled by the stomach. In general raw vegetables low in protein, as carrots, celery, tomatoes, cabbage, lettuce and cucumbers, leave the stomach rapidly, develop moderately high free acidities but little combined acidity and leave the stomach without great change. Boiled vegetables show much more rapid and complete disintegration. Vegetables high in starch, such as potatoes, show very considerable starch digestion before leaving the stomach. In certain cases hardly any starch reaction could be obtained toward the end of digestion.

The average evacuation time for puddings in all subjects is two hours and eighteen minutes as against two hours and twenty-seven minutes for pie and three hours and two minutes for cake. Averaging the highest total acidity values for puddings it was 92, for pies 90, and for cakes 90. Direct comparisons of the three types of foods on the same individuals indicate that pies are handled more readily than cake, and puddings somewhat more readily than either. Fruit pies, such as apple, pumpkin, raisin and peach, leave the stomach in from two to two and three-fourths hours and develops a moderately high acidity (90 to 100). Most of the acidity is due to free HCl, the acid combining powers of these pies being low. Custard pie leaves the stomach in moderate time and possesses a fairly high acid combining power. Mince pie requires a longer time to leave the stomach and develops high total and combined acidities. The addition of ice cream to a small piece of pie does not increase the burden of the stomach to any marked extent. The addition of cheese to apple pie does not increase the digestion time.

Candies depress secretion and delay evacuation in proportion to their sugar content and the amounts of them ingested. Candies should not be eaten before but after meals. Hard candies which must be sucked are preferable to cream candies. Soft candies such as bon-bons, soft creamy wafers and the interiors of chocolate creams exert as depressing action on gastric secretion and evacuation as concentrated sugar solutions. Chocolate appears to stimulate gastric secretion. Gum drops seem to leave the stomach rapidly with little acid production. Plain marshmallows remain in the stomach rather long, but after being toasted leave the stomach rapidly and give rise to high intragastric acidities.

The evacuation of the stomach is not appreciably delayed by the drinking of 1 liter of cold water, cold or hot tea, hot coffee, plain or with cream, or with sugar and cream. The addition of sugar alone to coffee delays evacuation. Cocoa is somewhat slow in evacuating. Coffee with sugar alone delays the development of gastric acidity. Coffee with sugar and cream has less effect.

In the work of these observers on the psychic secretion of gastric juice in normal man it is found that the sight alone of a table well set with nourishing foods gives rise to a distinct secretion of gastric juice. It was true of the sight of half a grape fruit. The sight of the same foods ill prepared and poorly served results in no stimulation of appetite secretion. The odor of frying meat or any odors of food produces less stimulation than the sight alone. The tasting and chewing of food in the absence of smell or sight produces no marked psychic secretion. The combined influence of the tasting, chewing and smelling of food was pronounced and much greater than that of smell alone. The sound and

thought of a frying steak may give rise to a gastric secretion. Anxiety and mental strain markedly delay gastric digestion. Pavlov and others have shown in animals that fear and rage may exert a most pronounced inhibiting effect on gastric peristalsis and secretion. It is also known that the clinical symptoms of gastric ulcer may be aggravated by emotional excitement due apparently to delayed evacuation associated with the hypersecretion of gastric juice commonly found in such cases. There is no doubt of the clinical significance of a purely emotional dyspepsia and this may serve as an additional warning to all not to unnecessarily carry troubles to the dinner table.

The effects of alcohol in the rates of discharge from the stomach studied by Wright<sup>2</sup> proved what was well known in a clinical way that moderate amounts of alcohol stimulate the secretion of gastric juice and also more rapid expulsion of the gastric contents. This is probably due, not only to a more vigorous peristalsis, but also to a more prompt acidulation of the contents. When stronger alcohol is taken, however, retardation of the output takes place, in all probability, due to the effects on both peristalsis and secretion. The profound influence of the stronger alcohol on the central nervous system indicates that the nerves of the gastric wall and possibly also the muscle fibers, are similarly affected, and the weakness of the peristaltic waves supports that supposition. Pavlov has shown that strong alcohol causes an abundant secretion of mucus, neutral or faintly alkaline in reaction. It is easy to understand how the stronger alcohol mixed with foods produces so marked a slowing of gastric discharge and the very moderate use of it is most helpful in stimulating secretion and evacuation from the stomach.

When the gastric digestion is slow (the primary atonies, pylorospasm, nervous hypomotility, chronic gastritis, pyloric stenosis), it is of service to select such foods as make but small demands upon the stomach and which pass out quickly. By doing this, we serve to prevent the degree of subjective distress, control the dangers of gastric fermentation, and assist generally toward better systemic nutrition. Of assistance here, is the following table, quoted from Penzoldt, of the time in which definite quantities of the various foods leave the stomach in health. As all fluids pass through the stomach rather quickly they have not been included.

*From one to two hours:—*

- 100 to 200 Gm. milk, boiled.
- 200 Gm. meat broth (no addition).
- 100 " eggs, soft.
- 200 " beer.

*From two to three hours:—*

- 200 Gm. cocoa with milk.
- 200 " light wines.
- 400 " beer.
- 300 to 500 Gm. milk, boiled.
- 100 Gm. eggs in any style.
- 100 " beef sausage, raw.
- 250 " calf's brain, boiled.
- 200 " fish boiled.
- 75 " oysters.
- 150 " cauliflower, boiled.
- 150 " potatoes, boiled or mashed.
- 70 " light bread, fresh or stale.
- 50 to 70 Gm. of biscuits, zwieback or crackers.

*From three to four hours:—*

- 230 Gm. spring chicken, partridge or squab boiled.
- 190 " spring chicken, partridge or squab broiled.
- 250 " beef, raw or cooked.
- 160 " ham, boiled.
- 100 " roast veal.
- 100 " beefsteak, raw-scraped, chopped.
- 100 " roast beef.
- 200 " fish, boiled.
- 150 " breads, biscuits, cereals, vegetables, and fruits.

*From four to five hours:—*

- 210 Gm. squab, broiled.
- 250 " fillet beef, beefsteak, broiled.
- 250 " beef's tongue.
- 250 " ham, broiled.
- 250 " goose, roasted.
- 280 " duck, roasted.
- 150 " lentils, purée.
- 200 " peas, purée.
- 150 " string beans, boiled.

The above list does not include many of the foods ordinarily used, but is quite representative of food classes, and from these, their amounts, the estimation of total elements, and the comparison of those which are not included fair general calculations of all can be made to indicate the degree of retardation. Selection from a more ample list is often necessary in those who have idiosyncrasies to certain foods, or because some might favorably affect constipation, diarrhea, types of enteric disturbances, etc.

In the pyloric stenoses, a liquid or semifluid diet is essential, because of the difficulty of the more solid foods in passing through the narrowed exit. In the benign stenoses, where the gastric secretion is good, more solid foods (meats, fish, bread, purées) or those containing more protein can safely be employed, providing they are taken in small particles. When the secretion is low or absent, the fluid diet is best, or the use of the more solid substances finely ground or powdered. To assist the emptying of the stomach in pyloric stenoses and to minimize the degree of fermentation, frequent feedings of small amounts, the

rather free use of water, and lying on the right side or back assist in the emptying of the stomach.

As with the pyloric stenoses, atonies, and pylorospasms—where we feed fluids in small quantities frequently to meet the dynamic deficiency or embarrassment—when the gastric mucosa is irritated (hyperesthesia, gastralgia, post-ulcer irritations), or to save the degree of irritation from the presence of foods, or to avoid the dangers of prolonged gastric digestion (ulcer, erosions, gastrorrhagia), the fluid diet should be the first one installed. But in these last-mentioned conditions, frequent feeding need not be resorted to, because these stomachs usually empty themselves well, and frequent feeding may cause local irritation, whether the diet be fluid or not.

Opinion is still divided on the wisest plan of diet for the cases of oversecretion of gastric juice. Where the acid is high (hyperchlorhydria, acute ulcer, gastritis acida), the opinions range from a high protein diet to bind the acid on the one hand, and a carbohydrate to eventually control its formation on the other. The question will not be definitely settled by the type of controversy that rages, because different cases cannot be figured by statistics on the simple question of acid alone. The entire subject is too complex for that. We must also take into consideration the amounts of mucus and the enzymotic power present in the gastric juice, the factor of the general systemic condition, and the facts pertaining to the healing of gastric or duodenal ulcers, etc.

Where the acid is higher than the amount of enzymes, as I have often observed, even in gastritis acida, the employment of a high protein diet (meats) is worthy of attention, and is commonly followed by benefit to the patient. But care must be exercised that in our efforts to bind all of the extra acid we do not cause the stomach to develop more coaptation secretion of HCl and cause the condition to become substantially worse. In planning the diet to utilize all of the acid, the more abundant use of the vegetable proteins is best, although the animal proteins should form the mainstay up to just short of the enzymotic content.

Beyond this point the animal proteins are much more irritating to these stomachs than the leguminous vegetables. But when the secretion of the stomach is low in mucus, and the acid content deficient, a diet of the mixed variety, but somewhat more plentiful in the vegetable proteins, gives the best results in the long run. Another plan, and the one I have had the most success with in a general way in high acid-enzymotic secretions, is to use all of the food constituents, but to give them in fluid and semifluid form, so as to keep down the element of mechanical

stimulation and irritation. For this, a diet of well-boiled cereals, milk and fresh cream, butter, breads and rolls, eggs and simple cake, answers admirably.

With the uncomplicated hyperchlorhydrias it is of practical value to observe whether the increased acid is due to just an acute nervous exacerbation, such as is commonly seen in neurotics of middle age, or if it is a well-established high and continuously present acidity. In the first, a high protein diet to bind the excess of free acid for a few days answers well. But in the more chronic cases, hyperchlorhydria chronica, whether accompanied by irregular secretion (gastrosuccorrhea) or not, a continued high protein diet prolongs the condition. In the beginning of the treatment in these chronic cases, to relieve the local distress this binding feeding is often of service. But it has been the author's observation that in the course of time the natural adaptability of the stomach causes it to digest the increased proteins, and the tendency is for the secretion to become permanently higher. To put these patients on a heavy vegetable diet in the beginning is also unwise, because in such a stomach the conversion of the total starches is low, even when much ptyalin had been incorporated with the food. It is sometimes best to begin high with the proteins, and then gradually curtail their quantities and supplant the shortage with carbohydrates. It is a system of working the secretion down, and it brings about the best permanent results. The fats are well borne in these cases of hyperacidity, and act as mechanical sedatives, or inhibit the secretion of the hydrochloric acid.

In acute *ulcus ventriculi*, each case may be figured upon the conditions of secretion that accompany it. In most of these cases, in the young and middle aged particularly, the acidity is high, and an ulcer is too *bona fide* and serious a condition to trifle with on points of dieting. All mechanical, chemical, and thermic irritations must be rigidly excluded; so it is best to keep the diet fluid, bland, and not too hot or too cold. This is more easily brought about by the use of a milk and egg diet. To these later may be added the vegetables in the form of purées, but meat and other solid foods had best be left out altogether until very late in the course of the treatment.

In the cases of deficient gastric secretion (hypochlorhydria, gastritis—particularly atrophic, and achylia gastrica) it is desirable to control the amounts of total proteins, and sustain nutrition more by carbohydrates and fats. Meats should not be excluded altogether, because the intestines can take charge of them if they are properly selected and finely cut. The vegetables in soft forms and the fats in good division are well borne by these stomachs.

In the sensory disturbances of the stomach, much depends upon whether they are primary in the stomach, or secondary to general neurotic conditions. In the primary type (such as gastralgias, hyperesthesia) foods and drink as free from thermic and mechanical irritation as possible, should be employed; usually a carefully selected soft mixed diet serves well in these cases. Where the condition is secondary (neurasthenia gastrica, crises of locomotor ataxia, reflexes from diseases of other organs) the same rule holds good in pronounced cases, although the general system must be looked upon as in a state of disturbed nutrition, and the diet soon maintained at a higher level to meet the requirement.

It is important that all foods be properly masticated before swallowing. This holds true particularly in the neurotic disturbances of the stomach. It is plain that in disturbed states of gastric secretion, large masses of food in the stomach not only increase the local distress but often lead to a serious protein loss through the bowels. When the gastric acidity is low, even when the pro-enzymes are present in sufficient quantities, thorough chewing is of much value to add the full amylolytic power of the saliva and render the chyme finer so that it can be more readily changed by the low acid content.

Important also, is the changing of the character of foods to meet the added catarrhal states due to warm weather. This also holds true in the summer intestinal conditions, such as in the acute and subacute intestinal diarrheas, and in the infective conditions of the gut.

In cases where vomiting, pain and immediate distress after ingestion are prominent features, changes in the character, temperature, and quantities of foods become essential.

All of the subject of special dieting is entered into with more detail in connection with the treatment of the various conditions. The above is intended only as a rough general draft on the subject. It can be truly stated that more mistakes are made in dieting gastro-enteric cases than good work done. As case after case comes to us, how often do we see patients of low nutrition, debilitated and anemic, in the production of which it is most suggestive that long processes of useless dieting have had strongly to do, and, on the other hand, we see cases in which a liberal license in the selection of foods has prevented recovery. The principles of dieting are not difficult to understand, and most patients are willing to apply and persist in following them, particularly when they are being benefited.

In the construction of a diet for a patient, we should take into consideration the general condition and the character of life that the person lives (active, physically or mentally, sedentary and so on); the

nature and extent of the abnormal gastro-enterological condition present; then the foods that should be digested with the best results, and lastly how and when they should be taken. To meet these indications, we have ample lists of the different foods and their caloric values in the various quantities to select from. All diet lists should be constructed in this definite way, for it is always wisest to decree to the patient what foods and amounts he should partake of, rather than the uncertain plan of general and indefinite direction, or of the still poorer one of giving a list of the "must not takes" in all cases.

#### SUBJECT-MATTER CONTRIBUTABLE TO DIETETICS.

Almost as numerous as the different races of people in this world, are the characters of foods of which they habitually partake. In the great civilized centers, where a variety of food is readily procurable, the diet is usually a mixed one, comprising a choice of wide selection to meet the palates of the differently disposed peoples. From the fat-eaters of the North, to the fruit and vegetable eaters of the torrid zones, through the meat-eating Aryan and Semitic races, scattered as they are all over the world, the fish and cereal-eating Easterners, and those living in the rural parts of civilized countries where the character of foods partaken of depends to a large extent on the possibilities that exist locally in the kinds that are obtainable, the greatest possible differences are seen.

Long-standing habits and customs of a people must be taken into consideration in the construction of dietaries, but not to the extent of the more definite indications or contraindications present in each individual case. This is true also with the real food idiosyncrasies of particular individuals. Where these latter exist (and they are common) they should be found out and the taking of such foods should not be insisted upon, because it is usually seen that these idiosyncrasies refer to foods which, in character and desirability, are not important. The specific question, "What foods have always disagreed with you?" will generally bring forth such articles of diet as "strawberries, all berries, brussels sprouts, cabbage, turnips, pears, bananas, fish, bologna, veal, sweets, etc." On the other hand, many patients with gastric disorders will relate the names of substances, such as soups, the rough vegetables, meats in quantities, sweets, and so on, which, before their illness, they could partake of with comfort and benefit, but which now seem to intensify their suffering. The reason for most of this often becomes apparent when an accurate diagnosis of the gastric condition has been made, since they are often found to be substances that irritate

the existing condition, or fail of digestion because of secretory deficiency in the gastro-intestinal canal.

Sometimes it will be noted that when it is important to keep up the supply of certain food groups, a change in the cooking (frying and boiling, *versus* roasting and broiling), or the nature in which they are served, as when drier, more fluid, scraped or chopped, or in the quantities and intervals in which they are taken, makes an important difference, and renders the badly borne ones possible of use. A choice variety of small quantities of those in the same group sometimes makes them acceptable and worthy of consideration. The intolerance of such important articles of diet and ready nutrition as eggs, milk, etc., should be looked into carefully, for these should be retained if at all possible in most cases.

Often in the stress of acute illness, patients will partake readily ~~of~~ of fluids and have an aversion for the more solid foods. Here, such ~~as~~ articles as milk, kephyr, buttermilk, albuminous and starchy drinks, ~~as~~ eggs in fruit juices, reinforced meat broths, cold or warm, often permit of the giving of sufficient caloric values, and at the same time ~~can~~ meet the conditions of lowered secretions and motility in the digestive ~~with~~ canal. In convalescence, of course, the semisolid and solid foods are ~~the~~ most useful as a basis of feeding.

The cooking of foods often changes their caloric values. It is ~~is~~ obvious that the addition of animal fats, butter, starches and so forth ~~which~~ which are added to meats and fish in roasting and frying, increase the ~~the~~ potential value of the food as a whole. The same is true with the ~~the~~ starchy foods.

Boiling hydrates the starches and thus renders them easier ~~of~~ conversion. But it solidifies the protein mass in meats of old ~~old~~ animals and that which is cooked too soon after killing. Boiling also ~~also~~ deprives the foods of the incorporated fats. Boiled milk is a little ~~a little~~ slower of digestion than raw milk; this is probably due to the coagulation of the milk albumin by the heat. The boiling of vegetables and fruits has no effect upon the sugars that may be contained in them ~~them~~, but it generally softens the mass, and in that way assists, with the hydration of the starches, in the ease of their digestion. Boiling has ~~has~~ a detrimental effect upon some foods; examples of this are lettuce ~~etc.~~, oysters, etc. In the oyster, for instance, a diastatic enzyme, which resides in the liver of the oyster, is destroyed by heat, and the whole mass is rendered tougher. Boiling favorably affects the protein of wheat (gluten), and renders it easier of gastric and pancreatic digestion. All styles of cooking young meat, fish, etc., soften and loosen the connective tissue and the denser structures in them, converting these into a soluble

gelatin and thereby freeing the fibers for easier attack by the secretions of digestion.

The art of good cooking is of greater importance for the ill than for the well. It is one of the noble efforts of modern education of the young in our schools that they are taught the principles of proper cooking. For here they learn not only the scientific side of the art, but also to use discretion, care, and cleanliness in the procedure of preparation. Second only to the added palatableness of cooked foods, is the proper seasoning of them. Many an anorexia succumbs to the subtle effects of this added zest, and few have not noticed the fact that new and strange dishes, attractively served, as they are in hotels and first-class restaurants, often induce the ingestion of more food than would be possible at home.

In the selection of foods, only the best qualities should be used—for those in health as well as the ill. Care should be exercised also that during the cooking process the utensils be covered with lids. Copper vessels should always be properly tinned, and earthen or porcelain ware pots should be preferred to all others. Most cooked foods should not be permitted to stand and again served at long intervals afterward; chemical changes are liable to take place which may lead to nausea and even to their ejection from the stomach by vomiting or from the intestines by a diarrhea. It is best to discard that which is not used, and keep the fresh foods on ice until utilized. Naturally, all pots should be scrupulously cleaned after use. Furthermore, food and drink should not be taken too hot or too cold. The use of salt is of course essential, but the employment of too much spicing is injurious—jaded palates can be appealed to without these by simply changing the nature of foods or employing other ways of cooking them. The use of citron, pomegranate, orange or lemon skins is also injudicious. The table should be set attractively, and the use of good dishes, table plate, flowers, attractive ways of serving, etc., are worthy of consideration, for one feeds with the eyes quite as much as with the mouth. Likewise, good friends and convivial company at the table betters the mental state and reflexly assists digestion. Grief robs us of our appetite and disturbs digestion.

During the first stage of active secretion of gastric juice after the meal, when the blood in large quantities is circulating within the walls of the stomach, it is best to rest or at least not engage in any active work. Care should also be taken not to bathe too soon before or after meals—one hour before and three hours afterward are safe intervals. Sleeping immediately after meals also partially arrests digestion.

The feeding of those acutely ill is a matter of vital importance, for the life of a patient often depends upon the degree of nutrition that

can be maintained during the acute stage, and on the recovery of strength during convalescence. When the fever is high, the body is losing weight rapidly, and the products of combustion, urea, carbonic acid, and water, are excreted in larger amounts. To replace these in acute illness we are at a disadvantage, because of the anorexia, poor assimilative power, and diminution in the quantities and efficiency of saliva, gastric and pancreatic juices and bile. Likewise, the stomach is sensitive and the general nervous system easily disturbed. Here, of course, the fluid foods, possibly in smaller quantities, are a boon to nutrition, and for this a good nurse is essential to prepare and administer them. When on a milk diet, the stools should be carefully watched for undigested curds; when these are present, peptonization or the use of diluents should be employed. Every careful observer has noticed that many patients are starved during acute illnesses by neglect or indifference to dietetic measures. The increase in body temperatures is less responsible for the loss of weight and strength than is the patient's inability to receive and digest the foods; therefore special and carefully prepared foods should be employed. Remissions of temperature should be taken advantage of, and the patient's feeding pushed at these times. During convalescence, an artful nurse can do more with skillfully prepared and artistically served foods to restore the patient than a physician can with tonics.

#### ARTIFICIAL FOODS.

By the term artificial foods is meant the proprietary or patented stuffs that are used for the feeding of the sick or under-nourished. They comprise collectively much too wide a range of different preparations, and their importance is not of enough value to enter into them in any detail. They are intended for use by those who are seriously ill and not able to partake of the more substantial regular foods; in cases of irritable stomachs, vomiting, etc.; as a way of giving proteins, carbohydrates, and fats in a more readily digested and assimilable form, such as in cases of lowered gastric digestion; and as a supplemental feeding for the under-nourished.

In the peptone or, better, the albumose preparations, the proteins of various kinds (casein, beef, etc.) have been acted upon artificially by the enzymes pepsin, papain, pancreatin, bromalin-pineapple and by the use of superheated steam. Among the most prominent of these may be mentioned Mosquera's Beef Powder, Sanatogen, Tropon, Somatose, Mulford's Predigested Beef, Liquid Peptonoids (a complex mixture), Leube-Rosenthal's Meat Solution, and Valentine's Meat Juice. Of

these Sanatogen and Tropon contain the largest percentage of albumin among the powders. Most of the liquid preparations contain alcohol in varying amounts, some of them as high as 30 per cent. It is obvious that the presence of alcohol in these large quantities vastly increases the caloric values of the preparations, but this increase is brought about in a most undesirable way and should not be employed in reckoning the value of the preparations as nutriments. If any are used, it is best to employ the powdered forms, because they contain a known quantity of albumose, and thus their value can be computed more accurately than the liquid varieties.

The carbohydrate preparations are mostly flour, starch, or sugar preparations, some containing soluble leguminose. Others again, are milk powders in varying amounts. Some fat preparations have been introduced, but excepting the oil and egg emulsions they have met with only scant attention.

Taking them all as a class, it may be said that they are but poor substitutes for foods themselves. The time will never arrive when *multum in parvo* feeding will sustain a human being in health, or be a food substitute for nourishing the sick. Their use is a starvation diet at the best. At the present time enough attention to the details of dietetics is not given in our medical schools, and a lack of knowledge has permitted the medical profession to place too much reliance upon these medicinal food substitutes.

The Council of Pharmacy and Chemistry of the American Medical Association have done praiseworthy work in investigating the nutritive value of a number of these predigested foods, and the results, as published in *The Journal of the American Medical Association*, May 11, 1907, are worthy of quotation:—

"In order to get a fair conception of the actual value of these various preparations, it is desirable to make some comparison which can be readily understood by every physician. The amount of good milk necessary each twenty-four hours to sustain the vitality of a patient during a serious illness is not less than 64 ounces, or approximately 2000 cubic centimeters. The food value in calories represented in this amount of good milk may be placed at 1430 calories. This includes not only the proteid and carbohydrate matter, but the fat as well. By comparing this available potential energy with the total energy in the predigested foods under consideration, it can be readily seen that if a physician depends upon the representations made by some of the manufacturers and feeds his patient accordingly, he is resorting to a starvation diet. The largest number of available calories, including alcohol, present in any of the recommended daily doses, is

less than one-fifth of the number of calories represented by 2000 cubic centimeters of milk; and the calories represented by the daily dose of the preparation poorest in food products is only one twenty-fifth of the amount present in 2000 cubic centimeters of milk. These figures tell their own story. Making 2000 cubic centimeters of milk the basis of calculation, and estimating the amount of the various preparations required to yield this number of calories, it is found that the quantity to be administered daily to supply 1430 calories, including alcohol, varies from 716.2 to 1506.2 cubic centimeters. In other words, it will be necessary, in order to supply 1430 units of energy per diem, to administer the amount of the various products in quantities found within the above limits. In many cases the amount of alcohol exhibited by these quantities would keep the patient in an alcoholic stupor continually. The cost necessary to supply this energy varies from \$1.48 to \$3.39. Compare these prices with the two quarts of milk. Is further comment necessary?"

There is no doubt that in the past many patients have suffered severely when these preparations have been used to sustain life. The fact that their names are easily remembered and spoken, falls far short of meeting the main indication for their use in maintaining nutrition. The truth is, that the reason they are so well borne by a disordered digestive tract when the regular foods are not, is because they have so little food value in them that they cause but little tax on the digestive powers. This fact holds true in their use in the chronic gastritis, gastric stagnation, ulcer, carcinoma, etc. A small place may be made for their use as supplemental foods, but not as the foundation of nutrition; or they may be used in a makeshift way as a very low diet in cases of very irritable stomachs, vomiting, hemorrhage, etc., to gap over a space of feeding for a few days and still satisfy the anxious relatives or friends about the patient.

Many home preparations can be made by a nurse that serve ~~as~~ well and most times better in all cases. Among these a few may be mentioned:—

- Milk, peptonized or plain.
- Milk, modified with water, barley water, vichy, seltzer, etc.
- Junket and whey.
- Kumyss, matzoon, buttermilk (plain or modified).
- Nutritious beef, mutton and chicken broths.
- Beef juice.
- Albuminous, starchy and chocolate drinks.
- Thin soups of various kinds.
- Gruels (reinforced or plain).

## NUTRIENT ENEMATA.

It has been shown conclusively that, even without previous peptonization, proteids may be absorbed in small quantities from the lower bowel. The same is true with emulsified fat, saccharated starch, the sugars themselves, and the inorganic salts and water. The addition of sodium chloride, particularly in the case of egg albumin, enhances the absorbability of the proteins; and when these elements have been previously peptonized, and thus more or less converted into the albumoses or peptones, their ease of absorption and the amounts taken up by the rectal and colonic mucous membrane are increased.

The nutritive enemata, however, judged by their results, are but poor substitutes for stomach feeding, and even in spite of the greatest care in preparing the bowel for the reception of the food, carefully selecting it, using only small quantities and peptonizing the foods, and the marshaling of all of the skill that a careful nurse can exercise in the work, failure is common. To present the various arguments as to whether only peptones should be used, and how much of the food elements are actually absorbed, etc., helps but little in this subject. The fact is, that in actual practice all classes of patients are met with, ranging from those in whom rectal feeding meets with scant success or downright failure from the very beginning or in a short time after its institution through all degrees to those in whom it is a practical method of great value. When rectal feeding is indicated it is always an uncertain and anxiously awaited problem as to what value it may be. There seems to be a different inherent power in different persons to benefit by this procedure. The author has seen cases where, with the exercise of the greatest care, so little food was absorbed or the gut became so quickly intolerant that it was of no practical value or had to be discontinued. In others, again, it may be kept up with satisfying success for days—one of my cases for over nine weeks. In addition to perfect technique, much depends upon an existing healthy condition of the lower gut, and the demands of the system for nutrition.

When foods are constantly being vomited from the stomach, or when because of stenotic conditions in the cardia or esophagus they cannot reach that organ, when it is advisable to allow the stomach to rest from secretion, motility, or irritability, or when we wish to supply foods to the body in addition to what may be put into the stomach, as in pyloric stenosis or subnutrition, the rectal route of feeding may have to be resorted to. But once begun, great care should be exercised that the technique be as perfect as possible, lest the gut becomes intolerant and the patient be deprived of its use altogether. So much benefit can be

derived from its use in some cases of late gastric carcinoma, gastric hemorrhage, recurrent gastric ulcer, gastralgia, uncontrollable vomiting, intense hyperesthesia of the stomach, etc., that the author feels constrained to give some consideration to the details of technique, compositions of the most practical enemas, etc.

It is important to deliver the nutritive enema in a sigmoid or rectum that is empty of scybalaous masses. For this reason it is best to first give a cleansing enema of normal salt solution (about 500 cubic centimeters), and wait until this has been expelled. The salt solution not only evacuates the lower bowel of feces, mucus, etc., but it has a beneficial effect upon the mucosa, serving to preserve this in a healthy condition for a longer time than would be the case if it had not been used or only plain water employed. It may further be stated that the previous use of the salt-water enema enhances the absorption of the food following it.

The best tube to use is one sufficiently stiff so as not to coil easily and of about 1.5 centimeters in diameter. Remembering that the absorptive power from the rectum is the least of the entire intestine, it is important to get the food as high as possible—at least 25 centimeters from the anus. If the food is delivered too low, it is liable to be quickly expelled because of the rapid distention of the rectum, and if it be retained for indefinite lengths of time, much of the enema may lie unabsorbed, decompose, and thus eventually irritate the mucosa of the rectum. It is best to lubricate the tube well with sweet almond oil, and introduce it slowly with a twisting movement, upward and backward. With care and skill, the end of the tube can always be placed within the dome of the rectum, the sigmoid, and under favorable conditions into the descending colon. Naturally, the higher it is introduced the better will be the results obtained, and in cases in which the procedure is to be kept up it has been the author's custom to use a length of tubing and attempt to deliver the meal into the descending colon, or into its transverse portion, not so difficult a matter when the tube is sufficiently stiff, or favoring positions of the body are employed, or an endoscopic tube is used to guide the colon tube into the sigmoid.

A recent important contribution on this by Soper detailing X-ray observations of the position of tubes properly passed argues against the possibility of entering the sigmoid or colon, and shows that only the dome of the rectum is reached, the remainder of the tube coiling upon itself in the rectum. As a further demonstration of the antiperistalsis carrying foods from this point upward is the fact that by the use of a bismuth suspension injected into the rectum with a short tube, in a short time the bismuth travels far enough upward to make possible the taking of a

good X-ray plate of the colon. However, the sigmoid may be slightly bent or absent, or the tip may be flooded into the sigmoid by manipulation and allow the fluid to run into the sigmoid, and thus a high instillation be possible.

To be successful, the enema should never be given in the sitting or dorsal position of the patient. Very ill patients should be placed on their left side and a hard cushion be used under the left buttock so as to have the sigmoid at a lower level than the anus. When patients are well enough to be moved about, this position can be made extreme, or better the knee-chest position employed, and in the latter instances only a short nozzle, such as the usual hard rubber tip, is all that is required for introduction.

The introduction of food is performed either with a syringe attached to the tube, or by having a length of tubing outside of the patient so that fluids poured into a glass funnel on the end of it can be raised high enough for gravity to force it to flow from the other end into the bowel. The food having been thoroughly mixed and strained through a piece of cheesecloth if there are any particles in it, is held in a pitcher from which it is poured gently and slowly into the funnel. This is then elevated so that its contents can trickle through the tube. In this way no air is introduced. With the funnel still raised the tube is then withdrawn, and the patient made to remain quiet for about twenty minutes. If properly given, it is rarely necessary to use the folded towel to make pressure on the anus to hold the enema back. It has been the author's custom to seldom employ more than 150 cubic centimeters of fluid, and to give the enemas from four to six times in the twenty-four hours. Under favorable conditions a greater quantity can be used, but it is best not to administer the feeding at shorter intervals than four hours.

The foods given in this way should be bland and unirritating, as condensed as possible, and given at the temperature of the blood, allowing for cooling on its passage through the tube ( $44^{\circ}$  C., or  $110^{\circ}$  F.). The addition of salt to the food aids materially in the absorption, and is particularly of service when eggs are used. Brandy and whiskey are sometimes of service in the food as a stimulant, but as a general practice they are best omitted since alcohol is too irritating. All the enemas, especially those containing milk, should be peptonized. It has been my custom to peptonize even the single egg and meat juice enemas. A good essence of pepsin is useful for accomplishing this, being better in my opinion for enemas than the dry forms of pepsin. This essence adds just enough alcohol to assist in the absorption of the peptones or proteoses. Should the rectal mucosa become irri-

tated, the addition of from five to ten drops of laudanum to the mixture is of service.

A great variety of formulas have been advanced for use. Some of them are too low in caloric value, and others again are too bulky to be safe for continued use in the average case. Among those that I employ and recommend are the following:—

I. Whites of two eggs .....	30.2
Peptonized milk (warm process) .....	90 c.c. or 3ijj 60.0
	<hr/>
Caloric value .....	90.2
II. Warm milk .....	130 c.c. or 3ivss 87.
Yellow of one egg .....	61.
Sanatogen .....	2 Gm. or gr. xxx 6.4
Grape-sugar .....	2 Gm. or gr. xxx 7.4
Table salt .....	1 Gm. or gr. xv 0.
	<hr/>
Caloric value .....	161.8
Whole peptonized for ten minutes with 2 c.c. of essence of pepsin.	
III. One whole egg .....	76.1
Table salt .....	1 Gm. or gr. xv 0.
Red wine or brandy .....	12 c.c. or 3iiss 28.
Peptonized milk (warm process) .....	90 c.c. or 3ijj 60.
	<hr/>
Caloric value .....	164.1

In suitable cases the above amounts can be increased or the formulas modified:—

*Boas' formula:*—

Milk .....	250 grams.
Yolks of .....	2 eggs.
Table salt .....	3 grams.
Red wine .....	1 tablespoonful.
Wheat starch .....	1 teaspoonful.

*Ewald's formula:*—

Wheat flour .....	40 grams.
Water or milk (lukewarm) .....	150 grams.
Eggs .....	1 or 2.
Table salt .....	3 grams.
Grape-sugar sol. (15 per cent.) .....	50 to 100 c.c.
Red wine .....	about 60 c.c.
Nutritive value .....	about 450 calories.

Because of the more thorough conversion, it may be best to employ the warm process for the peptonization of milk. Milk, whey, beef juice, peptones, and egg-solutions alone make very excellent nutritive enemata, and serve well as changes from the heavier combinations. When the enemas are kept up for a length of time, it is often wise to change their character from time to time. This often obviates the danger of establishing irritation of the rectum or colon.

Of late, considerable doubt has been raised about the nutritive efficacy of rectal feedings. According to the observations of Edsall and Miller to determine how much actual nutrient the body absorbed from the bowel, it is claimed that most of the solids remain unabsorbed, and only the saline and water constituents of the injection were utilized. Boyd and Robertson<sup>3</sup> concluded as a result of experiments that the most that can be absorbed amounts to from 240 to 645 calories, about one-quarter of the amount of nourishment required to maintain nutrition. These observations, in the author's opinion, are important in that they serve to show the futility of giving nutritive enemata too low in the bowel and also using those which are too bulky. Efforts should be made to reach as high in the colon as possible, and it is not impossible (and if carefully performed without danger to the patient) to have the meals reach the transverse and even the ascending colon, and, of course, the nearer to the ileocecal valve it comes (assisted by posture), the better would be its absorption.

Unless patients are in an extreme condition, the enema properly given and retained can be relied upon to sustain a fair degree of nutrition for a number of days and sometimes weeks. Improvement in weight, however, in many cases is due only to the absorption of water from the meal. Practical experience shows that enemata equal to 2000 calories per day are too bulky and uncertain. I believe that under favorable conditions about 1000 calories are all that can be expected to be utilized. In light-weight patients, constantly in bed, this would be almost sufficient to sustain metabolism without depriving the body tissues and fluids to any great extent. But even should this amount of calories fall short of the individual person, still, it is a practical saving as compared to the total loss from starvation when the fluids (salines) are used for enemata instead of them.

It must be remembered that the rectum is not designed for absorption, and the rule is that bulky rectal feedings are of little value, or cannot be kept up for a practical length of time. Often hours and days after an enema, the watery and soluble constituents had been absorbed and the solids were passed as introduced. These facts being true it is manifest that the older bulky mixtures should have been replaced by some solution of nutritive value that would more readily be absorbed. Such results come from the use of glucose or dextrose. Reach showed that the change in the respiratory quotient following rectal injections of glucose indicated that this substance was slowly absorbed. Tallerman studied the blood sugar content after rectal injection of glucose solution and found that the absorption at its maximum occurred in one hour and twenty minutes. The maximum amount which he found in the blood

after rectal injection was 0.03 per cent., whereas the maximum rise in blood sugar when it was taken by mouth at the end of thirty minutes was 0.05 or 0.06 per cent. increase. Thus absorption by mouth is three times as fast and almost double what it is when the glucose is given by the rectum. Von Noorden proved that dextrin is of far greater value than glucose, which being a colloid can be used in higher concentrations than glucose, and that its absorption will be continued over longer periods of time, so that the tissues are not flooded with sugar as freely as if glucose is used. This possibly is the explanation of the statement made by Ornstein, namely, that glucose given with starch is better absorbed than glucose given alone. The important point in this matter, however, is that Tallerman's research, combined with the observations made by others, would indicate that while predigested proteids given by rectum are of little or no value, carbohydrate injections so administered may be definitely relied upon, and this is the more important because in most cases in which nutrient enemata are believed to be necessary the patient is in greater need of nutrition through carbohydrates than nutrition produced by albuminous substances.

At the introduction of the "drip method" by Murphy for saline solutions, an improvement on rectal feeding technique took place. For this purpose Adler<sup>4</sup> uses 4 to 8 ounces of peptonized milk with 1 pint of 4 per cent. sugar solution, given three times a day. It is true that after an initial discomfort for a few days, it often can be kept up for two weeks. My best results, however, have come with dextrin or glucose solutions of 4 or 5 per cent. strengths, to which in the glucose solution 1 per cent. boiled starch may be added. The rectal tube should be small and the drip not more than 30 to the minute. Every few hours the rubber should be removed from the glass drip chamber and the rectal content syphoned out into a basin on the floor. Of late a far better practice by me is to employ a short tube from the catheter in the rectum to a funnel held in position just above the level of the abdomen. Into this the solution drips and flows into the body. With such an apparatus any marked retention of solution in the rectum will regurgitate into the funnel, can readily be seen, drained off promptly, and the number of drops controlled as many be required.

It is important to remember, as pointed out by Umber and observed on several occasions by myself, that a nutritive enema reflexly stimulates gastric secretion to about one-half of the amount that would be observed by the same food in the stomach. In recent observations of mine, however, I am convinced that the use of saline enemata for the purpose of sustaining the body causes a much higher secretion in the stomach than the nutritive ones do, and, therefore, I would

advise against the use of the saline in ulcer cases with hemorrhage which have a high hydrochloric acid secretion. When the necessity for food is keen and the body sensitive to nervous action, I have observed on two occasions that the entire gastro-intestinal canal slowly moves in peristaltic movement after a nutritive enema. One was a case of gastrorrhagia due to late hepatic cirrhosis, and the other recurrent hemorrhages due to an acute gastric ulcer. In the latter case, the movements persisted for about an hour after each injection, when they gradually subsided. The increase in secretion and motility are two points easily controlled by the use of alkalis (mineral) given by mouth and atropine sulphate hypodermically before each enema.

#### OTHER METHODS OF FEEDING.

**Duodenal Feeding.**—When it is possible to use a duodenal tube this should be used in preference to all artificial methods. The tube *in situ*, various mixtures of milk, raw eggs, glucose and other sugars can be employed, and nutritive balance easily maintained. With a large enough syringe or irrigating can or jar, 8 to 16 ounces (240 to 480 cubic centimeters) can be introduced three to six times a day. It is well to peptonize all such feedings. The introduction should be done slowly or nausea and marked distress may be set up during the introduction especially at the beginning of the inflow. It is well at the start of each introduction to drive some warm water through the tube to clean out the fenestra in the tip, which often fill with mucus. My practice is to flush out (clean) the tube with water at the end of each feeding.

**Gavage.**—Occasionally in the insane, or possibly in extreme states of anorexia, it would be necessary or advisable to resort to this method of feeding. In infants, particularly those that have been intubated for stenotic laryngeal affections, gavage becomes a necessity, and here the common and most successful practice is by passing the catheter downward through the nose, rather than through the mouth. In these instances, the tip of the tube runs along the floor of the nasal fossa and, striking the pharynx, bends downward in back of the soft palate and onward into the esophagus and stomach.

Gavage is the method of choice in the feeding of the unconscious. In these patients the procedure is not difficult to carry out, although sometimes it is necessary to exert quite a steady pressure at the tube's entrance into the esophagus before it will pass. Care must be taken with these patients, before the food is run down through the tube, that the end is surely in the stomach or gullet, and not in the respiratory canal. With a tube such as that commonly used (Ewald)

passed through the larynx, the end hole will permit, in all unconscious persons, of breathing through the apparatus without much evident distress. Before the meal is run down, it is advisable first to put the ear to the funnel and listen for respiratory sounds; with the tube in the proper place naturally these would not be heard.

The method is often of service to take advantage of an anorexia in undernourished patients in whom regular lavage is being carried on. I confess to having been guilty of the institution of a mock form of lavage in the case of a petulant young woman, who, because of a long-standing neurasthenia and somewhat irritated stomach, partook of only the most meagre amounts of food during the day. The pint of milk with two eggs she artificially received twice a day following the washings of her stomach did much to restore her to health again.

**Nutrition Through Fistula.**—This form of nutrition comes under consideration when the entrance to the stomach has been permanently occluded (benign or malignant stenoses of the pharynx, esophagus or cardia), in cases where, as a result of surgical operation, a permanent opening is made into the stomach for the purpose of passing foods directly into that organ, or when the stomach has been rendered useless by extensive carcinomatous growth in the body of the organ, and in gastric incapacity following the taking of corrosive poisons, and where nutrition may be maintained through a jejunal fistula made according to the Mayo operation.

In the malignant cases, of course, the method is resorted to also for the purpose of prolonging life. When the route to the stomach is clear, or the body of that organ is not involved in disease, the establishment of a gastric fistula should not be resorted to in preference to the much better results obtained from the gastro-enterostomies. But when, on the other hand, the entrance to that organ is impractical for the passage of foods, and the stenosis is not malignant (cicatricial contraction of the esophagus), the method is one of value.

The foods which are passed into such a fistula should be fluid or semisolid, and properly warmed. Care must be taken that the temperature of them is not too high, and it is best to regularly employ a thermometer for this purpose. The meals should be given finely subdivided, and too much carbohydrate is liable to cause excessive gastric fermentation. It is not necessary to peptonize any of the foods, and patients should lie down when these meals are being administered. The author has a patient, a man weighing 182 pounds, who, as a result of a complete cicatricial stenosis of the esophagus following the drinking of a quantity of strong lye solution which he mistook for

milk, has been feeding himself in this way most satisfactorily for over nine years.

**Subcutaneous Nutrition.**—As strange as it may seem to state it—because there is no actual nutrition present; a serviceable as well as simple measure, administered by the skin, is the use of the saline infusion. By this method, it is only possible to supply the necessary quota of fluids to the body, and we must depend upon the tissues of the body to supply the material for metabolism for the time being, a not altogether dangerous thing to do in extreme cases of gastric hemorrhage, when for any reason it is not practical or may be thought unwise to employ rectal feedings. The method advanced by Murphy of proctoclysis may be employed instead.

Peptones and albumoses when introduced under the skin are not absorbed and produce toxic effects in addition. The carbohydrates (sugars) are with difficulty absorbed, and the pain caused by them and the small amounts which are taken up make their utilization of no practical value. The fats, as v. Leube<sup>5</sup> has shown, are taken up in quantities of from 50 to 100 grams at a time. The fat should be in the form of a bland oil which had been sterilized, and allowed to run under the skin by the funnel and long tube method using a long trocar, or, better still, pressed under the skin by means of a special apparatus. It is a painful procedure although in my experience not so much so as in the case of the sugar solution. It may, however, be worthy of a trial for a short time in extreme cases.

It can be said in conclusion that, taking it all in all, as good if not better results can be obtained by the use of the simple saline solutions alone as by other combinations, and on these it is sometimes surprising how well sustained many persons will remain for a few days if they are given no foods in any form, providing sufficient water is supplied them.

**Dietetic Cures in Gastric Diseases.**—There are certain undeniable facts connected with the structure of the human body and the customs of centuries in which man has lived which answer well the one-sided teachings of any special cure advocate. In his make-up of anatomy and physiology, man may be said to occupy a middle ground between the carbohydrate-eating herbivora and the meat or fish (protein) eating carnivora. In this middle ground, a debate has been waged for years in which the glycogen and fat of the meat foods are not fully considered by the meat-eaters who advocate the taking of albumin, fibrin and myosin, and the egg albumin, legumin, casein, and gluten of the vegetables given their position of grace by the vegetarian. The truth of the matter is, Nature has provided man with few foods that are not more or less compound mixtures of all of the food elements, namely, protein, carbohy-

drates, fat, inorganic salts, and water, and she constituted and permitted him to safely accustom himself by life, environments, and necessities so that, wherever and however he may live, foods are at hand which will give him sustenance. Then there is the adaptability of man when he changes an old habit for a new one in the way of feeding. With him, the new food is assimilated by an ever-elastic physiology, whatever he may select for himself, providing always that he partakes of enough proper foods, and imbibes enough oxygen and water to maintain the vital equilibrium of life.

Milk is the example of an ideal food. It contains in happy combination casein and albumin (proteids), lactose sugar (carbohydrate), butter (fat), the inorganic salts, and water. Being a fluid, it is quickly delivered into the stomach, which it leaves rapidly, after which all of its constituents are entirely absorbed and utilized by the economy. In every way it is a sovereign nutriment for the sick.

In digestive disorders its employment is of service in many ways, but, just because of this, it is the height of empiricism to state that it is worthy of general therapeutic use and thus establish it as a cure for all digestive disorders (milk cure). When taken even in large quantities (3 liters a day), most healthy individuals cannot be perfectly sustained by it, simply because it does not meet the nitrogen equilibrium and does not carry enough carbohydrate and fat to maintain full nutrition and metabolism. I have also observed that total milk feeding is an anemia-producing diet.

Whenever we wish to avoid the irritation of foods on the gastric mucosa (ulcer of the stomach and duodenum, the irritative neuroses, etc.) the exclusive use of milk is most useful. Its fluid nature makes it of great service in the stenoses of the pylorus, and in many of the conditions of intestinal origin. Its blandness and high proteid composition make it of value where the HCl content of the gastric juice is high, and when we wish to "bind the acid" and thus save the stomach from the irritation of an excessive free acidity. It is of great service as a nutriment for the very ill, and as a supplemental food taken between meals and before bedtime for the tubercular, neurasthenic, undernourished, poorly developed, etc.

In the catarrhs of the stomach where gastric secretion is low or the mucous production is much increased, excessive milk feeding is not well borne and may do actual harm. This is also true of the cases of primary gastric atonies, wherein the weight of it drags the lower part of the stomach down still farther, and often its fermentation causes an added distention of the organ—two particularly bad features in gastric myasthenias. In diarrheal conditions, most of which no doubt are

bacterial, milk might serve as a culture media for the organisms and prolong such conditions; this is also true in many of the flatulent disorders of the enteron. Many gastro-intestinal cases are also accompanied by a constipation, which condition is made worse by systematic milk feeding. When a diarrhea results from its employment, it is probably bacterial in its origin, and its use should be discontinued at once rather than change the form in which the milk is taken. In conclusion, it may be stated that there are persons who report that milk is badly borne. It should always be found out definitely, where exclusive milk feeding is indicated, that this is a *bona fide* condition and not just an assumption on the part of the patient from an aversion to it.

In those very few instances of intolerance to milk, its modification by certain mixtures, such as barley, lime, or arrack water, plain water, Vichy or seltzer, or even the addition of a little alcohol or brandy, frequently effects better conditions for digestion. Peptonization of the milk is, however, the best course to pursue when it is not well digested.

A most useful form of milk is fresh cream, which contains from 8 to 20 per cent. of fat. This can be added to whole milk to increase its caloric value, or taken plain diluted with water, Vichy, seltzer, etc. Cream itself makes an excellent supplemental food, and I have often observed stomachs which would tolerate this and reject plain milk.

Of value indeed, are the fermented milks, kephyr, kumiss, matzoon and buttermilk. In the acute and subacute gastric conditions, particularly those that are secondary to other illnesses, these are most valuable. The fermented milks are often of more service than peptonized cows' milk, and in cases in which vomiting is a prominent symptom I have observed that they can exert a sedative action on the stomach. In the paretic and atonic conditions of the stomach the use of buttermilk or plain milk which had been acted upon by the lactic acid bacillus (Lactone Tablets<sup>6</sup>) is of service. This is due to the lactic and butyric acid present in the milks, making up for a shortage of HCl and the stimulating effects upon peristalsis. Boas<sup>7</sup> reports satisfactory results from the use of one, two, and three days' kephyr in constipation, intestinal atony, and habitual diarrhea.

The ordinary form of vegetarian diet is worthy of recognition in the treatment of digestive disorders. In its strictest sense (exclusive of milk, cream, butter, cheese, eggs, etc.—which are animal products), and depending upon the carbohydrates alone, it should never be utilized, because really it is a diet of abstinence, much too bulky, and contains too much indigestible wood substance (cellulose) for safe or comfortable digestion. It may be said that the best form of vegetable diet

is a combination of vegetable carbohydrates and proteins to which the bland but highly nourishing animal food derivatives have been added. Only this combination is considered in the following lines. The ideal diet is a combined one of the lowest amount of animal protein and animal fats, to which the work and fuel supplying carbohydrates of the vegetables have been added in sufficient amounts to protect them. The carbohydrates, as has been mentioned before, are the great protein spares. Further than this, the nature and chemical character of vegetable foods can be taken advantage of to meet certain indications that may be present in gastro-intestinal disorders (dynamic forms of constipation, etc.).

Care must be taken when a bland or fluid diet (milk, cream, eggs, liquid albuminoids, etc.) is being used for a time, that we guard against the development of states of relaxation or atonies which they encourage to develop by the low degree of peristalsis that is required for their digestion. At these times, the vegetables, fruits, and to a lesser degree the meats, are of signal value. Also, the more thorough digestion and absorption of a high protein diet leaves but a small amount of residue in the colon, and constipation, particularly when the bland foods are being used, becomes a troublesome feature in most of the cases—here again the use of the vegetable foods, because of their mechanical stimulation and the bulkiness they give to the feces, is of value. The use of the carbohydrates is of excellent service in cases of low or absent secretions of gastric juice where such are not due to malignant disease (subacid and atrophic gastritis), for usually, the less the specific secretion, the better they are borne by the stomach. But when there is a diminished peristalsis accompanying the gastric affection, or when, on the other hand, a hypermotility exists, care must be exercised that the irritation of a bulky and more or less indigestible vegetable diet does not cause more relaxation in the first instance, or an aggravation of the condition in the second. In sensitive stomachs, such as is present in the irritative neuroses, *gastralgia*, *hyperchlorhydria*, those that are mechanically embarrassed (*pyloric kinking due to gastrophtosis*), sometimes in *neurasthenia gastrica*, and of course in *ulcers*, the use of the rougher vegetables (*cabbage, brussels sprouts, kohl rabi, beets, seeds and skins of fruits, etc.*) had best be withheld from the diet, whatever accompanying conditions there may be present which would suggest their use.

The rest cure, and particularly the feed and rest cure, occupies a minor yet important place in the treatment of digestive disorders. These, like all other routine therapeutic agencies, are of service in indicated cases, and are injudicious to inaugurate in a patient who does not definitely belong to that class. Practically, it may be said,

they are of benefit in the hysterical conditions, less so in the neurasthenic, and of harm in the hypochondriacal. They are of the most value in the low constitutional conditions of a nutritional nature wherein the digestive disturbance is secondary rather than primary in nature. Here, the rest permits of an adding to the loss of energy, and a high feeding, from 3 to 4 thousand or more caloric units, builds up the nutrition of the system. In the neurasthenias in which the manifestations are markedly of an irritative or psychical nature, rest and isolation are valuable measures in the control of the neurotic condition, both systemic and gastro-enterological. In the neurasthenias or pseudo-neurasthenias of strictly gastro-enteric origin, the poorest results are obtained by these methods of treatment, and it is the author's observation that it is best not to advise their use. Likewise, in the neurotic cases caused by the chronic gastritides the results are poorer than when patients are handled in the up and routine of life way—by regulation of habits and hygiene, attention to diet, rest, exercise, medicinal and mechanical treatments, tonics, hydrotherapeutic measures, etc. Whenever true organic affection of the stomach exists (ectasia, myasthenia, gastritis), one should hesitate to institute a "rest and feed" cure, because it may be found that the results are not only poor, but oftentimes, when kept up for weeks at a time, positively harmful. Sometimes, however, even in those cases where we wish to control very prominent neurotic symptoms and closely observe a patient for a week or two, a modified form of the cure is of value.

The complete cure should take from three to five weeks, and the length of time should be definitely stated to the patient and relatives in advance, and then sternly carried out when the course has once been instituted. Large quantities of milk during the treatment are not essential, and may even be most harmful (atony, increase of catarrhal conditions, constipation, etc.). The feeding should be quite general, and rather large in quantities of cream, carbohydrates, and fats. Regular general massage is of value from a nutritional standpoint, for the passive exercises make up for the absence of the active; it also assists in the better distribution of the fats. Electricity is not of any value, excepting in a suggestive way, on impressionable patients. Baths are most valuable; the cold douches or cold salt morning rubs are invigorating and stimulating, and the hot spinal douches are quite sedative for insomnia; the enforced rest and quiet may be kept up to a certain time each day (say 1 o'clock), and then the patient be permitted a release of an hour or two from his thraldom, during which he can walk, engage in a few mild matters, such as gentle conversation with a friend, reading, etc., but not in any games of competition or matters of business.

The number of instances of gastro-intestinal conditions in which the thoroughly carried out rest cure would be advisable are few; but in what may be considered the modified form, very many. Accepting the stern principles of the cure as standards in the first instance, modification can be made in these to meet many of the indications in neurotic digestive cases and the results be perfectly satisfactory. To best describe this, it may be said that the same principles in shorter form are instituted in people who are up and engaged during the day. A close study of the individual case and the individual himself is at first essential. Then, observing the indications, we find out accurately what, in the mode and habits of his life, militate against these, and institute a change of them along the rest-cure lines. This naturally opens up too ample a field to enter into in minute detail, and since these neurotic cases differ so much, the author will depend upon the judgment of the physician in easily and properly meeting them. A few of these may be mentioned.

Patients can be made to take more rest at night—retiring at 8 P. M. and arising at 8 A. M.—this gives twelve full hours, and even if they are not asleep all of the time, by remaining in bed they are resting from the excitement and the strength-robbing effects of active life. The hours of business and work can be materially curtailed, and the hours of pleasure and diversion increased or stopped altogether as may be indicated. A change from home to some suburban district where the noises are fewer and the atmosphere of better quality than in the city may be wise. The keeping open of sleeping-room windows during the night and the institution of invigorating or sedative baths can easily be carried out. Morning exercise regularly conducted, and walking and playing mildly contested and non-exhausting games (as golf) are health-giving diversions to many of these neurotic cases. A diet can be followed that is constructive to the body and non-irritating to the stomach. It is important to be definite in substances, amounts, and the times of the day they should be taken. When the body becomes stronger, the abnormal condition of the digestive tract also improves; this in turn means better digestion because of better absorption and assimilation. With the full amount of oxygen inhaled, metabolism and general body construction are improved, and this again reacts to the benefit of the digestive canal, and thus a beneficial circle is set up. During the working hours, supplemental meals of a fluid, highly nutritious and bland nature (milk, crackers, eggs, cocoa, farinaceous foods) can be taken; these are best taken between the regular meals. The non-irritating tonics can be used, and other medication and hygienic matters as are found indicated in the case. Plainly, such a better

course of life can be kept up for months, and the results in the end be quite as good as those following the rigid rest cure for a short time.

It is interesting to note that the noblest exponent and perfector of the so-called rest cure should have been an American (Weir Mitchell). For in this country surely, particularly with many of our women patients, it came as a worthy medical legacy and blessing. But in this same land where hysterical progression, stern competition, and excessive work have made such vast progress, are found many individuals who cannot keep from, would not lessen, or who should not resort to these nerve-racking forces, and in these, as well as in those who suffer from neurotic and asthenic digestive disorders, the simpler cure, along the same lines, has, from a clinical standpoint, a place in medicine for all days to come. It is particularly appropriate for the man having business interests which require his daily observation. The taking of a rest cure in a sanatorium or the going away into the country for weeks at a time is an impossible thing for him in the activity of a business season. Then again, should he have taken our advice and fulfilled the requirements of a rest cure or a sojourn away from business, he usually reverts again to the activities that have assailed his health before. For him, as well as for those not ill enough to demand such radical measures in the first instance, the modified form above suggested is most valuable.

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<sup>2</sup> WRIGHT: Boston Med. and Surgical Journal, Vol. lxxv, No. 18.

<sup>3</sup> BOYD AND ROBERTSON: Scottish Medical and Surgical Journal, March, 1906.

<sup>4</sup> ADLER: Amer. Jour. Med. Sc., Oct., 1915.

<sup>5</sup> V. LEUBE: Verdauundlungen des 13 Krongresses für innere Medicin, 1905.

<sup>6</sup> PARKE, DAVIS & Co., Detroit, Michigan.

<sup>7</sup> BOAS: "Diseases of the Stomach," p. 310.

## CHAPTER XI.

### Medicinal Treatments.

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#### THE ACIDS.

IN deficiency or absence of the normal HCl secretion in the stomach, acids are used to render the medium favorable in reaction for the activation of the pro-enzymes that are secreted, if possible to regulate the pyloric reflex and cause stimulation of the duodenal mucosa for a higher status of intestinal digestion, to act as a local stimulant and tonic to the stomach by exciting a greater amount of HCl secretion, to act as an antiseptic, and for diagnostic purposes.

In a deficit of HCl, rationally, one would desire to supply acid in amounts and at such times after meals as would be necessary to acidify the chyme to secure gastric digestion, which, of course, would be variable in each case according as the gastric analysis displays information of the diminution of the secretion. Considering that an Ewald test-meal removed in the height of its digestion (60 minutes) showed a moderate decrease of secretion (subacidity), less quantities of the acid should be employed than in anachlorhydria, and its administration should not take place until the stomach has had time to secrete its own quantity of acid first. Then again, should amounts of food larger than are present in the Ewald meal have been ingested, and particularly when such meals are more highly albuminoid and mixed in character, it makes a difference in the quantity and interval after meals at which the acid is taken. These remarks pertain to individuals who are suffering from digestive disorder, and not those who have had a deficiency or absence of HCl secretion for years without any symptoms.

As to the benefits which come from the administration of the acids to assist gastric digestion and the doses in which they should be taken, there is a wide variety of opinions on the part of various observers. Schüle<sup>1</sup> claimed that the use of hydrochloric acid showed no effect at all even in large doses, and Boas<sup>2</sup> practically agrees with him and states that it is far more likely that the acid exerts an influence on the motility of the organ and in this way benefits digestion. While, in the author's observations, the administration of hydrochloric acid does act as a motor stimulant to the stomach and assists in the emptying of

the organ during digestion, it is difficult to agree that its use in suitable instances is without chemical benefit to digestion. The crux of the question in cases of subchlorhydria or anachlorhydria is: Are pro-enzymes present in the gastric juice of the individual or not, and if they are present is there sufficient acid secretion to activate the ferment regularly secreted or not? A low or absent HCl content in test-meals is no more an indication for the administration of acids than is that of any cloud in the sky, of rain. To administer acids to a case which has an achylic condition in so far as all of the digestive secretions are concerned is manifestly short-sighted medicine, and the same is true when only small quantities of the proferments are present and there is normally enough acid to activate them. The subject has to do mainly with the pathology of the enzymotic gland cells and the state of the secreting mechanism of the organ. In cancer, for instance, the acid secretion is usually the first to go, and for a short time in its early decline the administration of the acids can be of some benefit to the case. But when, as commonly occurs, the combined acid-enzymotic secretion is absent, the giving of the acids is of no value and often causes intense subjective distress; the same is true in atrophic gastritis, and those rare and of short duration cases of achylia due to neurotic disturbance in the secreting function of the organ (achylia is here used as referring to an absence of all stomach secretions, excepting mucus, which is the proper designation of the term, and not simply to an anachlorhydria). In most of the cases of simple chronic gastritis where the proferments are present, the acids are of immense benefit in assisting digestion and relieving subjective symptoms, and often in stimulating a higher normal HCl secretion, and as a stomach tonic. In late cases, when little pro-enzymes are formed, it is of no value, particularly when much mucus is present in the organ; in these instances its use, especially in large doses, acts as an irritant to the organ and therefore should not be given. In selected cases of the depressed forms of secretory neurosis when pro-enzymes are present, it is capable of much benefit, both in the immediate chemical and motor way, relieving symptoms, and also as a local stimulant to normal secretion of gastric juice and thus, indirectly, as a general tonic to the body.

As to the dose to employ, Riegel<sup>3</sup> was correct in determining this according to the individual case. In some instances very small doses taken late after eating suffice, and in others, Ewald's<sup>4</sup> suggestion of large doses (90 to 100 drops) may be required. Care must be taken, however, not to give more acid than would just be necessary for full saturation, and it must be remembered that, when administered under proper conditions, the stomachic effects from the acid are not due to the

effects of the free acid itself on the mucosa directly stimulating more secretion, but indirectly to the tonic effects on the entire stomach as an organ from the better status of digestion taking place in it. For the purpose, the pure hydrochloric acid (31.9 per cent. absolute HCl), or acidum hydrochloricum dilutum (10 per cent. absolute HCl), well diluted, are the best forms to employ. My individual preference is for the diluted acid because of the mitigation of the caustic effect in handling, and also to prevent the fear that the fuming acid often excites in nervous and apprehensive individuals. When the digestive action of the acid is desired, 8 to 15 drops of the pure acid or 25 to 50 drops of the dilute acid are dissolved in a tumbler of water, and taken at 15 or 30 minute intervals after meals, using about one-quarter of the quantity at a time, and continuing until the glass is empty. The freshly made nitrohydrochloric acid, or the dilute form, may be used instead, and is the better preparation to employ in the chronic forms of gastritis of alcoholics when the stomachic effects of the acid are desired. On these occasions it is best to employ the acid before meals, and to combine it with one of the bitters, such as the following:—

B Acidi nitrohydrochlorici diluti .....	6.5	3iss
Syrupi aurantii .....	40.0	3x
Tincturæ gentianæ compositæ .....	20.0	3v
Aquæ .....	q. s. ad	100.0 3ij

Misce et sig.: Take one tablespoonful three times daily before meals in half a glass of water.

The nitrohydrochloric acid for practical purposes can be made by adding 1 part of nitric acid to 4 parts of hydrochloric acid, and the dilute form is approximately a 10 per cent. absolute acid. In order to protect the teeth and obviate the disagreeable sensation in the mouth, these acids should be taken through a glass tube and the mouth well rinsed with an alkaline solution afterward, or the teeth cleansed with a little bicarbonate of soda on a toothbrush.

The question as to whether the administration of hydrochloric acid alone can bring back the normal acid secretion has been answered differently. From Jaworski, who claims that the gastric secretion of acid is lowered by prolonged administration, through L. Wolff, who noted no change in the chemistry after a week's administration, to Riegel, Reichman, Mintz, and others, who could demonstrate free HCl in stomachs in cases in which no secretion existed before its employment, there is a wide variety of opinions. My belief from many observations on the subject, is that the acid is administered by not carefully selecting the cases according to the existing pathology of each. Hydrochloric acid can cause a slight increase of HCl secretion when organic or malignant change has not robbed the individual of the pro-enzyme

secretion; this can easily be proven by its employment in many of the neurotic conditions of a depressed nature even when an anachlorhydria has existed for a length of time. But, as a rule, its administration as regards both dose and time must be carefully regulated in each case, and care must also be taken not to discontinue its use too soon or keep it up too long; these can be judged by frequent test-meal analyses in each instance. The acids are occasionally employed as an antiseptic in the stomach. For this purpose they may be taken at any time in reference to meals, on an empty stomach, between meals, or night and morning. My preference in those low secretion cases with bacterial increase is to give it in the usual way after meals on the empirical observation that I have seen the doses to be more efficacious at these times. For these cases, the giving of the acids is only a poor substitute for regular lavage, particularly when this is done with a weak HCl solution. A solution of the acid sometimes serves a good purpose in making a diagnosis of gastric ulcer of the acute type. There are cases of such in which the symptoms are only suggestive and in which the cardinal symptoms of pain, excessive vomiting, hematemesis, etc., are absent or present only in a very modified form. In a few of these, the giving of 50 drops of the dilute acid in half a tumbler of water on an empty stomach will occasionally excite a boring pain in the stomach, nausea, vomiting, etc., by its irritating chemical effect on the ulcer surface. It is good practice to give pepsin with the hydrochloric acid, especially in the achylia cases.

The contraindications to the use of hydrochloric acid are, of course, states of high secretion, hypermotility, hyperesthesia and gastralgia, and the irritative organic states of the stomach. Care should be used in employing it in cases of apparent subacidity when a hyperesthesia exists, because, as Riegel has pointed out, and which is dealt with more fully elsewhere in this volume, these may be instances of an excessive secretion for that stomach in the first instance, even if the acid secretion be low in a small quantity of the filtrate.

#### ALKALIES.

Since the days of Claude Bernard, who found that small doses of the alkalies have a stimulating effect on the gastric secretion and the taking of large quantities neutralized the acidity of the gastric juice in animals, the alkalies have been largely employed in the treatment of digestive disorders. In suitable cases it can definitely be said that their use comprises one of the most valuable medicaments we have for the relief of subjective symptoms in the majority of cases of gastric disorders that come to the clinician, and the reason for this is that states

of high secretion make up the majority of the functional, neurotic, and mild organic disorders that are encountered.

More extensively than the discussion of the acids, the controversy has waged for years as to the value of the alkalies in stimulating a higher HCl secretion, all authorities having agreed as to their neutralizing effect in excessive HCl secretion. In my opinion, the alkalies taken before meals are of no practical value for stimulating a higher secretion. The benefits in this way in cases of chronic gastritis (in which the HCl is usually lowered) reported from Carlsbad, Vichy, Vals, and other springs are not due to direct specific medical virtue in the waters, but to the regular routine of living, freedom from depressing business and domestic worries, fresh air, good sleep, abstinence from alcohol, the dissolving effects of the alkaline waters on the adherent gastric mucus, and purgative effects from the sulphate salts. It is probable, as Hemmeter<sup>5</sup> has suggested, that the taking of an alkali before meals could act as an irritant to the mucosa and set up a secretory reaction in about the same manner as a saline solution to the nasal mucosa would excite a mucous flow. But this is not always the case in the stomach, and not at all so unless the gastric mucosa and the secreting apparatus are normal.

In hyperchlorhydria and hyperchylia, the alkalies are usually given after meals at the time when the symptoms of irritation from the free acid manifest themselves (pain, distress, pyrosis, distention of the stomach, eructations, etc.), and in such quantities as is necessary to control the symptoms. Their employment may be kept up for long periods of time without danger to the stomach, although care must be taken when the commonly employed bicarbonate or dried carbonate of soda is used, that, from the generation of large amounts of CO<sub>2</sub>, a myasthenia or atony from distention does not develop, or that the "bicarbonate of soda habit" is not contracted in which often viciously large doses are habitually taken. In gastrosuccorrhea bicarbonate of soda may be taken between meals, although the use of the alkaline milk or egg albumin is decidedly best for relieving the distress; the same may be said of cases late in the treatment of acute gastric ulcer in which the HCl continues excessive. Sometimes in a case of hyperacidity the giving of the alkalies before the meals relieves the symptoms better than when they are taken after the meals. Altogether, it must be said that the use of the alkalies, as well as the acids, is only a temporary measure, and that the institution of more rational means for the permanent relief of these secretory states is by far the best medicine (lavage, dieting, hygiene, better mode of life, etc.).

Of the alkalies employed there are the solid forms and the alkaline waters from various springs. The first comprise alkalies in combination

with carbonic acid and vegetable acids (sodium carbonate, bicarbonate, and citrate), and those combined with the earthy alkalies (magnesia usta, magnesium ammonio-phosphate, and bismuth subcarbonate). The order of these in their power of neutralization is as follows: magnesium usta (calcined magnesia), magnesium ammonio-phosphate, sodium bicarbonate, sodium carbonate exsic., and bismuth subcarbonate; the last possesses the additional value of being a mechanical sedative and about three times as valuable an antacid as the subnitrate salt. Alkalies are often of use to relieve the pain of ulcer, in which instances it should be given in fairly large doses frequently repeated.

Belladonna and its most active alkaloid, atropine, are also most valuable in an indirect way by inhibiting the secretion of the stomach, and are most valuable additions to the alkalies in very high hyperchlorhydria and gastrosuccorrhea. However in hyperacidity cases atropine cannot be proven to be a practical antacid. In continuous secretion it checks the secretion only in maximum doses, and the same is true of spasm. It is not uncommon to bring about a subjective benefit, probably by its depressing effect on the vagi nerves. The formulas I have found most useful in my practice are the following:—

In hyperchlorhydria (digestive increase of acid):—

R Magnesii oxidi ponderosi,  
Sodii carbonatis,  
Bismuthi subcarbonatis,  
Saccharii lactis .....  $\ddot{\text{a}}\ddot{\text{a}}$  15.0 3iv

M. et fiat pulv. Sig.: Take one-half a teaspoonful in water, one hour after meals.

Or,

R Magnesii oxidi ponderosi ..... 10.0 3iiss  
Bismuthi subnitratis ..... 20.0 3v  
Syrupi acaciæ,  
Aqua destillatae .....  $\ddot{\text{a}}\ddot{\text{a}}$  q. s. ad 200.0 5vij

Misce et sig.: Take one tablespoonful, one-half, one, or two hours after meals (as the case may require).

Or, when constipation exists,

R Magnesii oxidi ponderosi ..... 10.0 3iiss  
Misturæ rhei et sodæ ..... 200.0 5vij

Misce et sig.: Take one tablespoonful immediately, one-half or one hour after meals (as the case may require). Extract of cascara sagrada may be added to the above and the dose of mist. rhei et sodæ lowered to a dessertspoonful.

Or, when a mixture of powder is not handy,

R Magnesii oxidi ponderosi,  
Bismuthi subcarbonatis,  
Pulveris rhei .....  $\ddot{\text{a}}\ddot{\text{a}}$  25.0 3vj

Fiant tab. no. L.

Sig.: Take one or two tablets one-half, one, or two hours after meals (as the case may require).

In gastrosuccorrhea (continuous secretion of acid),

B Extracti belladonnæ .....	0.3	gr. v
Bismuthi carbonatis .....	15.0	3iv

Fiant tab. vel chart. no. xx.

Sig.: Take one before meals and one of the antacids above after meals.

Or,

B Extracti belladonnæ .....	0.2	gr. iiij
Sodii carbonatis .....	4.0	3ij

Magnesii oxidi ponderosi, Bismuthi bicarbonatis .....	aa	15.0	3iv
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M. et fiat pulv. Sig.: Take one teaspoonful one-half hour after meals  
(0.1 of strychnia sulphate may be added to the above in cases of atony).

The Carlsbad salts, or spring waters having like chemical compositions, form most valuable adjuncts to the treatment of these conditions. According to Professor E. Ludwig, the composition of the pulverized Sprudel salts is the following:—

Sodium sulphate .....	41.62	per cent
Potassium sulphate .....	3.31	" "
Sodium bicarbonate .....	36.11	" "
Sodium chloride .....	18.19	" "
Lithium carbonate .....	0.2	" "
Sodium borate .....	0.03	" "
Water .....	0.44	" "

An artificial Carlsbad salt (sal carolinum fractitium), made after the German Pharmacopeia, and supplied in both dry amorphous and crystalline forms, has essentially the same chemical composition as regards the most active salts. This contains in 100 parts:—

Sodium sulphate .....	44	parts.
Potassium sulphate .....	2	"
Sodium chloride .....	18	"
Sodium bicarbonate .....	36	"

After an extensive experience with both the imported and artificial variety, I must say that medicinally the original salt possesses no advantage over the other, so that of late, because of the cheapness and more universal procurability of the artificial salts, these are now almost exclusively used by me. Occasionally, the borate and lithium salts in the Sprudel salts make their choice of some additional value.

These salts can be administered in various ways, but best not after meals—because of the purgative action of the high sodium sulphate content, and the fact that as a distinct antacid the plain alkalies are more desirable. The instances in which they are most valuable are those combining constipation with the excessive acid secretion (most commonly observed), as in excessive secretion of the hyperchlorhydric and hyper-

chylic types, and in gastric ulcer. In my opinion, the best results are observed when from 4 to 10 grams are taken, well diluted in cold water (tumblerful), in the morning, on an empty stomach. This acts as a neutralizer to such gastric secretion as had accumulated in the empty stomach, a discutient to the mucus that is present, washing it into the intestine, and, after absorption into the general circulation and elimination by the lower portion of the colon, as a gentle, painless, quick, and short-acting purge. In this combined way decided benefit comes from its employment, particularly inasmuch as the salt is so well borne by the stomach that its use can be continued over a considerable length of time. This latter fact has several times been drawn to my attention in cases of gastric ulcer in which Rochelle, Epsom, and other salts had been used for their purgative action, and which salts, administered on the empty stomach, immediately caused violent pain in the organ, and sometimes vomiting and hematemesis. In gastritis acida I have occasionally found some benefit for a short time in giving about 1 gram of the Carlsbad salts fifteen minutes before meals. As a menstruum for the salts good drinking water or plain spring water may be used, or Vichy, Fachinger, Apollinaris, Saratoga alkaline, or Bedford spring water employed. Lastly, these salts, as well as bicarbonate of soda or lime water, may be used to good purpose in weak solutions in warm water for lavaging the stomach.

#### OILS.

Of late years the employment of oils in the local treatment of gastric disorders has received considerable attention. This is mostly due to the experiments of Cowie and Munson<sup>6</sup> on human beings, and the view of Pawlow<sup>7</sup> based upon animal experimentation, all agreeing that the influence of oils and fats is to decrease gastric acidity. A difference of opinion seems to exist between observers as to how this is brought about, Pawlow believing that the effect is exercised through reflex central stimulation of the inhibitory centers of these nerves, and that the mechanical action of the oil is very subordinate. On the other hand, Cowie and Munson believe that the effect is mostly local, acting in two ways—by covering and by coating the mucosa—thus keeping the food from direct contact with the mucosa and thereby limiting the stimulating effect and causing a lower secretion of acid. To this latter view I agree, although it must not be forgotten that in many of the excessive secretions of a neurotic, and even of a catarrhal nature, well-digested oil is a powerful reconstructor, energizer, and tissue saver, and by its constitutional effects could assist in bringing about a more normal condition of secretion in the stomach. It is a common clinical observation in many

of these cases, that when the oil is taken before meals on an empty stomach a much more marked subjective benefit is brought about than is noted when it is taken after meals (in fact, in most cases, when so taken no benefit and even distress may ensue). The reason for the latter is that olive or cotton-seed oil, taken during or after meals, retards the evacuation of foods from the organ, and thus its employment in atonic conditions of the organ is contraindicated. This rule, however, does not hold so true when such fats as butter or its suspended form in cream are employed, since these are usually taken in smaller amounts and are better borne (although even with these, particularly in cases of fat intolerance, distress may ensue).

In hypermotility and pyloric spasms the use of the oils before meals is rationally indicated. Particularly in pyloric spasm of cases in which the cause is unknown, or in the post-operative cases, whether there is much dilatation of the stomach or not, the instillation of about 100 grams of warmed oil or 50 grams of fresh butter in the empty stomach in the mornings, and more or less taken during the day, may cause the most striking benefit, both in the local relief of the subjective symptoms and also in the general status of nutrition. The effect upon constipation in poorly nourished neurotic persons with a high HCl secretion produced by the free use of oil is often most valuable.

In a certain class of cases, for which it is difficult to ascribe reasons, there is an intolerance of fats in any form. Whether this is due to poor fat digestion and absorption, or a difficulty in assimilating fats after absorption—and thus of metabolic nature—it is impossible with our present-day knowledge to say. But it is certainly true that with some patients in whom their use seems to be indicated, such foods rich in fats as milk, cream, butter, eggs, olive oil, and the like, cannot be taken without discomfort. Leaving out of consideration such conditions in which the use of fat would not be advisable (icterus, pancreatic disease, structural disease of the intestinal wall, some cases of diabetes, or phthisis), as Edsall<sup>8</sup> has pointed out and also as I believe, enough consideration has not been paid to this subject. In a number of cases that have been referred to me in whom these foods had been used with increasing distress to the patient, the giving of fat-free foods (skimmed milk, white of eggs, carbohydrates, green vegetables, etc.) has relieved the symptoms, regulated the bowels when a diarrhea existed, or controlled the constipation when the feces were hard and dry from condensation of calcium soap.

**LOCAL AND GENERAL TONICS.**

Of service in the treatment of stomach conditions is the use of local tonic measures.\* Among these, in suitable cases is the employment of lavage, proper dieting both to meet the chemico-dynamic condition of the organ and sometimes also in the effort to "work down" or "work up" the stomach functions, intragastric faradism, and lastly, the use of drugs for the same purpose, of which *nux vomica* and its alkaloid combinations of strychnine are by far the most active.

The very general use of *nux vomica* preparations in the treatment of gastric disorders has, even in the days of more empirical medicine, shown this drug to be of value. In the class of such useful remedies as opium, digitalis, quinine, etc., the use of *nux vomica* has received a very broad application. The main physiological action of the active principle of *nux vomica* is to increase the activity and power of the non-striated and the striated muscular fibers (thus its value in atonic states of the gastro-enteron, heart, arteries, etc.), as well as its stimulating effects on depressed states of the central nervous system. Although its physiological effect in producing dynamic and general stimulation is its main therapeutic action, it has in addition the power to increase the gastric secretion to a limited extent. Whether this is simply due to better motility and central nervous stimulation of the secreting apparatus it is impossible to say; but there is no doubt of some degree of power in this direction, particularly if the patient has appreciated the bitter taste of the drug when taking it, such as in the form of tincture of *nux vomica* or strychnine in solution (here, like all bitters, it probably reflexly stimulates gastric secretion by its peculiar persistent bitter taste).

In simple cases, such as after an attack of acute gastritis, mild neurotic conditions of a depressive nature, or in the waning digestive power of the aged, its dose need not be large, 5 to 10 drops of tincture of *nux vomica*, or 1 to 2 milligrams ( $\frac{1}{60}$  to  $\frac{1}{30}$  grain) of sulphate or nitrate of strychnine. But in atonic conditions of the stomach, or low secretory states, such as are present in chronic gastritis, larger-sized doses should be employed. It is well, however, since one cannot foretell what the patient's tolerance will be, to start with small doses and gradually increase the quantity. In marked cases of atony when the drug is well tolerated, I am not averse to giving as much as 20 or 30 drops of the tincture, or 4 or 8 milligrams of the soluble strychnine salt in water before meals. When the taste is complained of (some people like it) the tincture may be placed in soft elastic capsules, or strychnine may be employed mixed with lactose sugar and placed in cachets or made up in tablet or pill form. These high doses

may be continued for a length of time, but at the first suggestion of twitching or rigidity of the muscles the dose should be lowered or stopped for the time being.

Physostigmine salicylate (eserine salicylate) or physostigmine sulphate (eserine sulphate) may be mentioned in this connection as being used in gastric dilatation mostly in those acute cases that follow surgical operations. In a close study of the literature pertaining to the use of eserine in these cases, and considering the well-known properties of this drug, I fail to understand the rationale in the use of eserine for these conditions. The facts that the Calabar bean or its preparations produce muscular tremors by an effect upon the muscles themselves and also a rise in the arterial pressure, are but poor reasons for its employment in these cases when the well-known depressing effects of the drug are taken into consideration. Practically all of the successfully treated cases that have been reported in which this drug had been used were also treated by posture and lavage at the same time, and, in my opinion, the benefits from the treatment were due entirely to the latter, the case recovering in spite of the eserine. Strychnine is by far the safer and more efficient drug to employ, especially when one considers that our knowledge of the causative factors at work in these surgical dilatations are still so little known. The drug is usually employed hypodermically, employing about 0.00065 gram, or  $\frac{1}{100}$  grain, at a time.

It may finally be mentioned that the best local tonic measures in stomach conditions are proper dieting, systematic lavage when the muscular walls of the organ are not much weakened, proper hygiene, general tonics, and electricity.

The general tonics that are so often employed in digestive cases are those that pertain to the broad field of medical conditions in which such measures may be indicated. Among a few of the medicaments and the preparations of them that deserve special mention and which I most frequently employ are the strictly hematinic tonics (iron, manganese), and the accessory substances that are usually added to them, such as strychnine, quinine, bichloride of mercury, etc., and lastly those medicaments that are classed as alteratives, such as arsenic, the iodides, etc. In the consideration of these, the author will touch upon their general clinical use and then detail their application in digestive conditions.

The commonest accompaniment to digestive disturbances is an anemia, observed in states all the way from a slight and severe type of secondary anemia to the more complex and pernicious form. Consequently, the use of one of the iron preparations is often called for in the treatment, and in the selection of the preparation a few

words would not be amiss. Upon the degree of anemia, depends the selection of the iron preparation, the proteid combinations (albuminate, peptonate, and the proprietary forms), the organic acid combinations (ferric citrate, or the soluble form ferri et ammonii citratis in vinum ferri), or the non-astringent forms (saccharated carbonate, used in Vallet's mass, Blaud's pills, or Griffith's mixture, ferri et ammonii or potassii tartratis, or the reduced iron) being desirable for the slight and moderate degrees of anemia, and some of these (such as Blaud's pills and their combination with other tonics in elixir forms), and the astringent varieties (tinct. ferri chloridi, ferri sulphatis) in the severe grades. Mixtures which have served me well in my practice are the following:—

In the neuroses, with anemia and constipation.

B. Tincturæ rhei,				
Tincturæ valerianæ .....	āā	10.0	3iiss	
Liq. ferri peptonati cum mangano (N. F.) .....	100.0	3iiss		

Misce et sig.: Take one or two teaspoonfuls after meals in water.

Or,

B. Sodii bromidi,				
Fluidextracti rhamni purshianæ .....	āā	10.0	3iiss	
Liquoris ferri alþuminati (N. F.) .....	100.0	3iiss		

Misce et sig.: Take one or two teaspoonfuls after meals in water.

In the absence of constipation, the rhubarb or cascara can be left out, and the bromide and valerian combined in the one mixture.

In myasthenia or atony with anemia the following is useful:—

B. Tincturæ nucis vomicæ .....	12.0	3ij	
Liquoris ferri albuminati (N. F.) .....	q. s. ad	150.0	3v

Misce et sig.: Take two teaspoonfuls after meals in water.

Strychnine sulphate may be used instead, and in weak heart action the nitrate salt is the preferable. Strychnine is an excellent corrective of acute digestive disorders in the aged. The albuminate of iron solution contains nearly 0.7 per cent. of metallic iron with 20 per cent. (by volume) of alcohol, and the solution of peptonate of iron with manganese about 25 per cent. (vol.) alcohol.

Of the dry forms of iron to be recommended for simple anemias are the following combinations:—

In the neuroses with anemia.

B. Zinci valeratis .....	5.0	3iss	
Ferri reducti .....	4.0	3j	
Fiant pil., tab., vel capsul. no. L.			

Sig.: Take one after meals.

Or in the depressed conditions with anemia, the desirable nascent form of Blaud pill may be given as:—

B Strychninæ sulphatis .....	0.07 gr. j
Ferri sulphatis .....	4.0 ʒij
Potassii carbonatis .....	8.0 ʒij

Fiant capsulæ vel pilulæ no. xxx.

Sig.: Take one, one-half or one hour after meals, tea never being drunk with the meal before taking.

In constipation, laxatives such as extract of cascara sagrada, aloin, etc., may be added to either one of the above two combinations, but it is always best to use these separately in some form before retiring, or in cases of high acidities, the Carlsbad salts in the morning before breakfast.

The following is an excellent formula in cases of persistent anorexia and anemia from whatever cause, and particularly in that of subacute or chronic gastritis:—

B Tincturæ nucis vomicæ .....	9.0 ʒiss
Elix. gentianæ cum tincturæ ferri chloridi (N. F.)	90.0 ʒij

Misce et sig.: Take one teaspoonful in water before meals.

In the average case (when non-malarial) quinine, unless used in very small doses, had best be left out of the combinations employed; the same may be said of the arsenic preparations, excepting possibly in the very severe grades of anemia where their short use may be of value, and also bichloride of mercury in non-syphilitic cases. The iodides and the syrup of hydriodic acid are of much value in syphilitic conditions affecting the gastro-enteron (which are usually late manifestations), and as an internal discutient and alterative in the aged. For the latter, in cases of general and also arterial sclerosis of the upper splanchnic area, the iodide preparations are always worthy of a trial. The doses of the iodide salts should be small (0.3, or 5 grains), taken in milk or water at meals, and continued for a length of time. It has been my observation that what cannot be accomplished by these small doses is not by larger ones, and then the chemical damage to the stomach from the medicaments is always a negative factor. Mainly for this reason in these cases, I most often employ the syrup of hydriodic acid taken well diluted before meals, to which a small amount of strychnine may often be added with advantage.

### SEDATIVES.

Because of the many neurotic conditions of the stomach both primary and secondary in nature, what may be termed as nerve seda-

tives are sometimes of service in the relief of the subjective symptoms. In hypermotility and spasmodic states of the organ itself or its orifices, as well as in the irritative conditions (high acid secretions, sensory disturbances such as neurasthenia gastrica, hyperesthesia, gastralgia), these may serve most valuably in the symptomatic treatment. The drugs which answer the best practical purpose in these instances are the bromides and preparations of valerian.

Of these, particularly in the more generally neurological conditions, the bromides are often most efficient relievers of symptoms of distress in the stomach. For this purpose it is sufficient and desirable to employ them after meals, and in such doses as may be necessary for the case. This latter, in my opinion, is very much a matter of personal equation in each individual, some persons receiving the desired benefits from 0.3 to 0.6 (5 to 10 grains) of the bromide of soda or potassium at a dose, others again requiring as much as 1.6 (25 grains) or more at a dose, the administration being continued for some time before results are noted.

While it is desirable with these, as with all other medicaments, to stop their administration as soon as possible, and employ more intelligent medicinal means to arrive at results along more rational lines, still, the bromides (and also valerian) may be continued in moderate doses for a length of time without danger to the stomach. Thus it is that their doses should be decreased as the case improves, remembering at all times that in the use of the bromides the physiological action is essentially depressing in nature.

Valerian is a gentle stimulant, especially to the nervous system, but without any narcotic effects. It has been used empirically for many years in the treatment of functional nervous disorders, especially in such as hysteria, hypochondriasis, and neuralgia, sometimes with benefit, sometimes without. In neurasthenic conditions affecting mainly the gastro-enteric canal its employment is well worth a trial, particularly when used in combinations with strychnine, zinc, or iron. There being no objection to its use (excepting the unpleasant smell), and, even in large doses, no untoward effect on the stomach, its various preparations may be added to such other formulas as are employed, some of which (with the bromides) are found included in the general tonics.

A few others which have at times served me well are the following:—

In clean-cut neurotic conditions, where the gastric functions seem to be normal:—

B Sodii bromidi ..... 8.0 3ij (or more)  
Aqua menthae piperitae ..... 60.0 5ij

Misce et sig.: Take a teaspoonful after meals in water.

Or,

B Sodii bromidi,  
Tincturæ valerianæ ..... aa 10.0 3ss  
Aquæ ..... 100.0 3iiss  
Misce et sig.: Take a teaspoonful after meals in water.

Or, when anemia is present,

B Quininæ valerianæ,  
Ferri valerianæ,  
Zinci valeratis ..... aa 2.0 3ss  
Fiant capsulæ, pilulæ, vel tab. no. xxx.  
Sig.: Take one after meals.

Or, when constipation exists,

B Tincturæ rhei,  
Tincturæ valerianæ ..... aa 10.0 3ss  
Misce et sig.: Take 20 drops after meals in water.

Belladonna and its most active alkaloid, atropine, may be mentioned in this connection as sedatives to employ in cases of excessive secretion. While the unpleasant effects from their use (dryness of the throat, thirst, eye symptoms, hot skin, etc.) are deterrent to their general employment, they nevertheless, in my belief, comprise the most valuable medicaments we have for these conditions. It may be considered as a practical fact, that a digestive hyperchlorhydria, a persistent hyperchlorhydria, and a gastrosuccorrhea are simply grades or degrees of states of excessive secretion, and that any medicament which, by its physical action, can control the output of gastric juice in this way would be a rational remedy to employ. This is well borne out in the handling of these cases, and, in the author's belief, this remedy has not received the broad application its use deserves in the treatment of these common gastric conditions. Here, again, it may be argued that belladonna is only temporary in its effects and does not possess the properties for a cure. I myself consider that such measures as proper dieting, regular living, freedom from mental strain, sojourn in the country, etc., give by far more permanent results; still, there is a fact, not mentioned elsewhere to my knowledge, that a stomach condition which has once worked up a high secretion of whatever degree and which is then treated under conditions of life in which this was developed does not respond as quickly, nor does it continue as permanently in the lower secretion, when treated by dieting and the alkalies alone as when belladonna (atropine) has also been employed. It is a clinical observation of mine that an amount of HCl beyond the saturation of food present in the stomach can, by virtue of its chemical irritation, cause still greater gastric juice secretion, and for this reason alone belladonna is most valuable. In hypermotility and spasmodic states of the organ it often serves a good purpose by its anti-

spasmodic properties, and since these conditions are commonly present with excessive secretion, and in many acute ulcers, it is doubly useful. In acute gastric ulcer it serves an excellent purpose in holding down the coaptation HCl from the Lenhardt proteid fluid diet, and its use protects the gastric mucosa during the course of repair. In the treatment of the average case of digestive hyperchlorhydria its use is but rarely necessary, proper dieting and the alkalies answering well enough. In persistent hyperchlorhydria and gastrosuccorrea it is best given about half an hour before meals, and in some cases of gastrosuccorrea (of very high degrees) and in acute ulcer, 0.2 to 0.8 (4 to 8 drops) of tincture of belladonna, or 0.0003 atropine sulphate may be given every 3 or 4 hours during the day; in ulcer, the graver the case and the higher the amount of fluid proteids taken, the larger should be the dose, the quantity being cut to one-half or less (and continued) after the physiological symptoms from the drug appear.

The last sedative drug, the use of which is occasionally called for, is opium and its most important alkaloids, morphine and codeine. In very acute abdominal pain of the functional or catarrhal inflammatory types these drugs in a single or a few repeated doses are the most valuable means at our command to relieve excessive pain. Of course, when such simpler means as a mustard poultice over the area can control the distress—and this is a most efficient means to control vomiting—or an ice poultice, ice bag, or less active remedies internally answer for the purpose, they should be employed instead. Under no conditions should the opiates be used in the course of steady treatment of the average case, not even in the acute pains of gastric ulcer; this, however, excepts some of the cases of late cancer in which the relief of pain is about all we can do for treatment, and in which it is a matter of indifference whether the habit for the drug is contracted or not. Morphine acts well in relieving the pain due to the passing of gall-stones through the bile ducts, and also as an internal hemostatic in cases of acute hemorrhage.

#### ARTIFICIAL FERMENTS.

As a legacy from the days of medicine when little was known about the digestive functions, and when the treatment of digestive disturbances was based upon the flimsiest of data, the use of artificial ferments is still with us. Empirical medicine has much in its favor, but when it persists in the use of these substances in the treatment of digestive disorders, it is conservatism or irrationalism or medical ignorance continued too long. The main reason for the persistency in the use of them is due to the ferment propaganda that was and still is broadly

cast throughout the world by the proprietary houses supplying these preparations, and the alluring twinkle that such terms as "pepsin," "pancreatin," "malt diastase," and their combinations in high sounding names have for the much-too-busy general practitioner and the easy-to-impress patient with a digestive disorder. The time will come when workers in clinical medicine generally will learn that, even if the proteolytic ferment extracted from the hog can digest 3000 times its weight of egg albumin in a test-tube, such pepsin taken medicinally is a poor makeshift for scientific medicine; and the same holds true with trypsin.

Suffice it to recall that in the human being the ferment content of the stomach is not nearly so often diminished as is the HCl, and that even in what looks as an achylia (where the HCl is absent) the proferments are generally found in sufficient quantities to do the work needed should they be activated by HCl. The work of Pawlow showed plainly that the gastric secretions vary in composition and strength according to the sort and amount of food ingested, and that it is most doubtful that help may be given by the administration of small amounts of artificial pepsin. Sollman has shown that the preparations of ferments upon the market are almost, if not entirely, inert, either because they have degenerated after preparation, or because they were not active at the start. This is particularly true of the alcoholic preparations and the watery extracts of pepsin when these have been kept for any length of time (glycerin being the best liquid medium for their preservation).

For a fluid preparation of pepsin of an acid nature, when added to milk to produce a quick coagulum, proves only that the milk-curdling function (which persists the longer) is at work and not that thoroughly active pepsin is present, and it is well known that milk proteid coagulated artificially is less easily digested than the original milk proteid. Rennin action is of insignificance in the digestion of proteids, since it is absent in the new-born, and its large amount in the adult stomach is the reason for the adult's relatively smaller digestibility of milk as a food.

Added to these is the well-known fact that pepsin is destroyed in an alkaline medium (anachlorhydria, achylia), and that trypsin is destroyed in a weak acid medium almost as quickly (the majority of stomachs in disease have more or less acid). Then again, when in combination, pepsin destroys trypsin, and trypsin destroys pepsin, and, as was said before, they both deteriorate quickly in all fluid preparations unless most carefully protected. Thus it will be seen that the use of the ferments, plain or in mixtures, is irrational and ineffectual, and such benefit as may have been apparent from their use has been

due either to other substances that are contained in these preparations (such as an acid and alcohol), other medicaments that had been added to them in the prescribing of mixtures or powders of the ferments, to the mental effect on the patient from "taking pepsin," or just to the suggestive effect on a patient of being under a physician's care for digestive trouble and for which he is taking medicine.

The best medical practice is to change the diet in quality and form so as to meet the chemical and dynamic power of the stomach, and to employ such more dependable local means and general measures as may be called for to work this power up to a higher standard of digestive capacity, or decrease it, as the case may be.

If one can be sure in a given case that there is no secretion in the stomach (achylia), and that the organ is a mere receptacle for food, the use of pancreatin, pancreas powder, or "holadin," and rendering the food alkaline with bicarbonate or carbonate of soda, assists in the proteolysis and amylolysis of food, and thus favors a better state of digestion and utilization of food in the economy. In such cases the stomach may be considered in function as practically a part of the small intestine. "Gastron" has been used by the author with rather striking results at times.

The above remarks on the animal ferments comprise essentially the author's ideas on the therapeutic use of also the vegetable ferments (nepenthin, bromelin, and papain).

### STOMÁCHICS.

The above term has been given to substances capable of increasing the amount of gastric juice secreted. In this particular there is no substance known which by virtue of its chemical action upon the interior of the stomach can directly increase the acid-enzymotic secretion. In my opinion, the substances classed as aromatics (the condiments, orange, lemon, garlic, onion, etc.) when used in foods can by their odor reflexly cause a short duration of gastric juice secretion, and the substances classed as bitters (gentian, cinchona, colombo, condurango, bitter orange peel, etc.) can increase the gastric juice secretion in the same reflex way, only the first is by way of the olfactory sense, and the second through the sense of taste. I doubt very much that when once swallowed, unless their effect when taken in large amounts is irritating to the gastric mucosa, any benefit from increasing the gastric secretion comes from their use. Strychnine or tincture nux vomica leaves the most persistent bitter taste in the mouth of any of the bitters, and it is most probably due entirely to this that the use of it can occasionally

raise the amount of stomach secretion, although, being an admirable nerve and muscle stimulant, it can (when the secretory or motor apparatus of the stomach is below par functionally) by an indirect constitutional action bring about a higher status of secretion. Orexin, which was strongly indorsed by Penzoldt, who called it a "genuine" stomachic, has been extensively used in anorexia and low secretion. Given in 0.65 quantities in bouillon before meals, it acts in the same way as other bitter substances, namely, by its pungent, bitter taste (I have proven to myself that it does not cause the secretion of gastric juice or increase it when its taste is marked).

The formulas which have served me to the best purpose in stimulating a desire for food and assisting to increased secretion are the following :—

B Tincturæ nucis vomicæ,  
Fluidextracti condurango ..... aa 15.0 3iv  
Aquaæ cinnamomi ..... q. s. ad 100.0 3iiiss

Misce et sig.: Take a teaspoonful in half a tumbler of water before meals.

Or,

B Tincturæ nucis vomicæ ..... 10.0 3iiss  
Elixiris gentianæ (N. F.) ..... q. s. ad 100.0 3ij

Misce et sig.: Take a teaspoonful (or two) before meals, well diluted.

Or, when constipation is present,

B Fluidextracti rhamni purshianæ,  
Fluidextracti condurango ..... aa 15.0 3iv

Misce et sig.: Take 20 drops before meals in water.

It is a well-known fact that with the prolonged employment of a diet free from chlorides (salt-free diet) more or less rapid diminution of the HCl output in the stomach takes place, and may even disappear altogether, and on the contrary, that the prolonged use of a very salty diet and salty enemas may give rise to an excessive secretion in the organ. For these reasons, and because salt may stimulate the appetite by its pleasant taste, and its necessity as a constituent in the animal economy to maintain good nutrition, its use in larger quantities will occasionally serve a good purpose in cases of subacidity or anachlorhydria. In the same connection it must be remembered, that, while in moderate quantities it may act as a stimulant, in large amounts it can inhibit the gastric functions. Being well acquainted with two apparently normal individuals whose generous use of salt in foods at the table often created comment, I took advantage of the opportunity and made analysis of simple test-meals extracted from each. Both results proved to be low in the total HCl content (17° and 36° total HCl respectively in the two individuals), although the rest of the analyses

were normal. It is probably best to leave each normal individual to his own desire in the amount of salt that he ordinarily adds to his meals, although in the presence of digestive disorder, and since patients do not always possess this sense of salt selection within themselves, it is well to increase or diminish the amounts of table salt taken according to the gastric analysis of the case.

In the existence of what may be generally termed a pathological stomach, proper dieting, the stimulating effects from regular lavage, the local and general tonics, and better hygiene of living are by far the better and more rational measures to employ to "work up" gastric juice secretion than the use of any single means or definite formulas of stomachic mixtures.

#### OTHER MEDICAMENTS.

Of these the author will only touch upon a few of the many substances that are used.

*Alcohol.*—Functional and organic disturbances of the stomach are both the cause and effect of the use of alcohol. In all forms (even in beers and light wines, which are low in percentage of alcohol) alcohol is a dangerous remedy to employ for stomach disorders, for, while it may stimulate a desire for food and perhaps cause a higher degree of gastric juice secretion, it (alcohol) eventually diminishes the nutrition of the body, and when taken in any quantity (brandy, whisky) is highly irritating to the stomach walls.

L. Kast<sup>9</sup> in his observations (a case of gastric fistula) regarding the effects of alcohol on the human stomach found that alcohol stimulated the digestive secretion in the organ, and that the duration of flow was increased beyond that possible of stimulation by water or the common food substances, but—important to note—that even in dilutions of 10 per cent. the increased flow pertained only to the HCl and not to the enzymes. Continuing his experiments upon dogs, he observed that in a dilution of 10 to 20 per cent. the secretion of gastric juice is still more actively stimulated and at the same time the mucus was increased, and that in dilutions stronger than this the secreting time was shortened and the mucus still more increased, over 50 per cent. alcohol producing relatively little HCl and abundant mucus, and over 70 per cent. being a corrosive to the gastric mucosa by its disintegrating effect upon the albumin.

While one may argue in favor of the use of alcohol that it is an active stimulant to HCl and that in small quantities its employment seems to be harmless to the stomach, the above observations prove, in my opinion, that such action as it has is from the very beginning to the

end that of an irritant to the mucosa. In depressed states of secretion of a functional type, the short use of a dilute alcoholic beverage with meals may be of some practical benefit; still, when one considers the commonly seen clinical sequence of its steady use—hypersecretion, secondary catarrhal process, then the diminution of the pro-enzymes and finally loss of HCl and pro-enzymes from changes in the glandularis, with atony of the secreting parenchyma, and atony or hypertrophy of the muscularis with thinning out, or round-cell and fibrous infiltration of the gastric walls—for the treatment of digestive disorders its use might better be left out. In a normal stomach, an occasional drink or two of an alcoholic beverage would not be especially harmful—the accommodating stomach can correct itself after them; but since the use of alcoholic drinks first began, and certainly to-day in many of the races and collections of people in our great centers of life, there is too much social and habitual drinking of these fluids with the meals for the safety of the digestive apparatus, not to speak of its baneful effect on the other specialized tissues of the body, or the moral and domestic view of the subject. It would have been far better for the world if alcohol had never been discovered; medicine could just as well have gotten on without it.

Late in the treatment of acute catarrhal conditions of the stomach (subacute gastritis) when a purge seems to be indicated, the use of *calomel* in small-sized doses (0.01) frequently repeated usually acts most efficiently in the desired way, and often is a most practical sedative for vomiting. On these occasions, the excellent remedy *oleum ricini*, so helpful at most other times, is liable to precipitate another acute attack with violent pains in the abdomen. *Bismuth subnitrate* is a more efficient mechanical sedative in vomiting and diarrhea than is the subcarbonate salt, although the subcarbonate is the better salt as an antacid. *Cerium oxalate*, used in much larger sized doses than is ordinarily recommended (0.3 to 0.6, or 5 to 10 grains), is often an efficient sedative to the stomach.

*Resorcinol* (the most soluble of all coal-tar derivatives) in 0.1 doses, and also creosote in 0.2 doses, are sometimes of value in excessive fermentative states of the stomach and intestines. Creosote is of no specific value in tubercular conditions of the abdominal organs, or, in fact, nowhere else in the body (in phthisis its sole value is that of a stimulating expectorant). In constipation *cascara sagrada* in fluid or dry extract form still remains the best laxative for continued use; *phenolphthalein*, recently advanced for use in this condition, is too uncertain in its results to depend upon for general use. In more obstinate cases when the taking of enemata is not convenient, refused

or not well borne, the following has served me to good purpose for continued use:—

B Ext. rhamni purshianæ .....	13.0	3iiiss
Podophyllini,		
Ext. belladonnae .....	ää	0.5 gr. viiss
Strychninæ sulphatis .....		0.07 gr. j

Fiant pil. or tab. no. c (coated).

Sig.: Take one or two at bedtime.

If such simpler means as the taking of fruits, or when the stomach conditions allow of it, the changing of the character of foods by increasing the ingestion of cellulose substances or increasing the ingestion of water, will keep the bowels regular, they should always be instituted. But in many cases the trouble with dietetic measures as well as with the use of the physical treatments is that these are not sufficient for the purpose. In those who live very sedentary lives, or who, because of having been constipated for years, have developed atrophic and atonic conditions of the lower intestine, the reading of text-books on the subject of constipation and the institution of the many time-wasting physico-hygienic measures that they enthusiastically advance are lamentably discouraging in their practical results. Occasionally, when a stomach condition has been corrected, the patient's bowels will move regularly, but not always. If not, the dietary and possibly the physical methods (exercise, massage, electricity, etc.) may then be tried.\* But if these also fail, the simplest medical means should be instituted. And should these fail, the enemas are better to employ as a steady practice than the continued use of the more drastic purgatives that the majority of patients select for themselves when specific advice in this direction has not been given.

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- <sup>7</sup> PAWLOW: *Berliner klinische Wochenschrift*, 1908, Nr. 11, p. 542.
- <sup>8</sup> EDSALL: *Boston Medical and Surgical Journal*, Dec. 26, 1906, clv. No. 26.
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\* In a number of instances of obstinately constipated persons I have seen most satisfactory results obtained from the eating of three or more bran gems each day made in the following way: Bran Gems.—2 cups of bran, 1 cup of milk, 1 cup of flour,  $\frac{1}{4}$  cup of molasses,  $\frac{1}{2}$  teaspoonful of baking soda (dissolved in hot water),  $\frac{1}{2}$  teaspoonful of butter,  $\frac{1}{2}$  teaspoonful of lard, and salt to taste. Bake in a slow oven for forty-five minutes. Any bran cracker or the "Kra Kie" biscuits may be used instead. Agar-agar in half-ounce quantities each day also answers to good purpose, and both it and the bran feedings may be used.

## CHAPTER XII.

### Physical Methods of Treatment in Gastric Disorders.

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#### MASSAGE AND VIBRATION.

IN the consideration of the subject of massage the author will confine himself to massage of the abdomen, the indications for its use, and the results he has observed by its systematic employment in gastric disorders.

While his observations have coincided with those who look upon hand massage of the general body as a therapy of considerable value, the results from its use in the stomach conditions alone have not been productive of much benefit and often have proven most harmful.

For one and a half years in the author's clinic, a number of cases of digestive disorders in which there was plainly a myasthenia or distinct mild degree of stagnation of food in the stomach and intestines, were put in the charge of a most conscientious trained nurse who had been a student of the late Zabudowski, of Berlin, whom I believe was the best modern authority on massage. The cases were carefully selected, and not one of them had much local organic or any malignant or systemic disorder. Apparently, they were as favorable cases for massage as could be found. In every one a diagnosis of the condition had first been made, and only those are considered in detail who came regularly to the clinic for this physical treatment.

The author has his doubts that any form of abdominal massage in gastric cases is a measure of practical benefit. From this series of cases, I have yet to see that, even by the most painstaking method, a tardy stomach can be emptied or even assisted to be emptied of food; or the secretion effected in any favorable way. On the other hand, I have observed cases of irritative states of the glandulature (chronic gastritis, hyperchlorhydria and gastrosuccorrhea, and the pure disturbances of sensation, hyperesthesia, gastralgia, neurasthenia) made definitely worse by the method.

In the intestinal cases of chronic atonic constipation, relaxation and flabbiness of the abdominal walls, distinctly better results were obtained. Usually I was able to prove to myself that in those of constipation in which the bowels moved after the treatments, which I

may say were not common even in the most simple cases, the resulting defecation was far short of an emptying of the sigmoid of the scybalous masses. In the relaxations of the abdominal walls, wherein one would suppose that hand massage would be of benefit to improve the tone of these voluntary muscles, the results from massage alone were far short of the benefits derived from the abdominal wall exercises alone. The method is of some value, however, to improve the general state of the abdomen as a whole, such as would be found in long-standing cases of digestive disorder, or in those who have led a sedentary life, but even in these cases I feel that as good results in the subjective way would have been obtained if the massage had only been given elsewhere on the body (passive exercise).

In the gastric cases, neurasthenia gastrica, and gastrophtosis with its neuromechanical syndrome, absolutely no results were obtained from massage alone, and in two cases of simple gastric atony decided harm was brought about by persisting in its employment. In two cases of pyloric stenosis, one a hypertrophic gastritis and the other a persistent pylorospasm, the stomach was quite as full at the end of a treatment as it was before it was begun. Even if such had not been so, I have my serious doubts, that, judged in the light of our latter day knowledge of the physiology at this important point of the alimentary canal, it would have been wisdom to force food through a pylorus into the intestine when this food by insufficient gastric preparation was not ready for the bowels—it is evident that you could only increase the baneful conditions of affairs by doing so. In several instances the nurse forsook the method of Zabudowski for evacuation of the stomach through the pylorus, and employed those set down by Penzoldt and Stintzing in their "Handbuch der Therapie," with just as indifferent results. Now, it occurs to me, that if this woman should have gotten such poor results from massage alone, what are the results possible of being obtained by those whose hands are less skilled than hers?

Because of the slipping and sliding nature of the stomach and intestines to any hand pressure that is possible of being exerted from without, and because it is a more directional method, I believe that the electrically run, large, rounded vibrator head, sunk deeply into the abdomen, will give decidedly better results in massage.

Lastly, it may be pointed out that any form of massage is contraindicated in ulcerated or malignant conditions, and also in those conditions of an acute or even a subacute inflammatory nature. This is also true where there is excessive secretion or motility, whether in the stomach or bowels or both together. It will, however, give the best

medical results possible to be obtained in cases of perigastric or perienteric adhesions, providing these are not too acute and sensitive in nature, although here surgery offers much better hope for permanent cure.

### ELECTRIC THERAPY.

**Intragastric Method.**—It is no doubt probable that the controversy on the use of electricity (intragastrically employed) as a therapeutic agent will continue until the nature of what this force is has been learned, and to what the therapeutic effects of it are, on the human body. To-day, on the one hand, these are the results of physiological experiment which decry its value, and on the other the results of clinical experience which many times are in its favor. Even among workers in stomach conditions, a wide variety of results are being reported. As an instance, Einhorn<sup>1</sup> is of the opinion that the faradic current promotes secretion and the galvanic impedes it; Hoffman, that the galvanic current increases secretion, and Brocci, that the faradic augments both secretion and peristalsis. It is the writer's belief that the effects of the galvanic current are somewhat of a sedative nature in the relief and control of abnormal disturbances of gastric sensations, and that it has a mild inhibitory effect on some stomachs on the hydrochloric acid secretion, but not as often on the quantity of enzymes; and that the faradic current is a therapy of value in the myasthenic states of the muscular tissue of the stomach providing the pylorus is patent, and also if the deficient musculature has not gone on to paralytic atony. Added to these, is an effect (probably complex in its nature) on the abdominal sympathetic system in which the nutrition of the stomach walls as a whole is improved; whether this is due to the massaging of the stomach walls by contracture of the muscle fibers from the current, or to some direct action of the current on the nerve endings and centers in the posterior abdomen, I cannot say; and lastly its use is a measure which has some beneficial effect in the suggestive way on susceptible persons who are suffering from gastric disorders of a neurotic nature.

Whatever may be the nature and degree of controversy that wages over the non-conductibility of the glandulature and musculature of the stomach to the currents in the effort to prove that the stomach cannot respond to this stimulus (Meltzer<sup>2</sup>), there is one practical test that controverts it all, and that is that when an electrode is within the stomach and surrounded by water so as to conduct the current to the mucosa, a circuit is readily made by an external electrode placed any-

where upon the surface of the body,—surely the current must pass through the stomach walls to do this.

I observed a few subjects, per X-ray, and proved to myself that the faradic current increases peristalsis and causes the entire stomach to become smaller in size. One was a case of gastrophtosis in a young woman, and another a simple atony following the taking of too large quantities of fluids in a young man who worked as a coal stoker in an engine room. My observations were conducted with bismuth subnitrate and water in an otherwise empty stomach, and I noted distinctly a mild running peristalsis in the lower half of the stomach in both instances. After the electrode was introduced and before the faradic current was turned on, the peristalsis was somewhat more marked, probably due to the presence of the string and end-piece within the organ. When, however, the faradic current was delivered to the tolerance of the person (external electrode at the sides of the neck), an evident contraction of the entire organ took place, followed by a less degree of relaxation and an increased peristalsis. The contracture was not so marked (although still increased) when the external electrode was on the dorsum or lumbar region of the back, and thus I have felt that with the electrode on the neck the stimulation of the pneumogastric along its course had to do with the intensity of it. Stimulation of the pneumogastric causes a contraction of the stomach.

Endeavoring to get some idea of the value of the continuous current on secretion, I took ten cases of hyperchlorhydria, placed them all on the same diet, and treated five with the daily use of the galvanic current for ten minutes at a séance, and the other five by the use of the mineral alkalies and gastric sedatives (bismuth salts and cerium oxalate), using no other treatment in all of the cases. I continued this for two weeks, and after a non-treatment intermission of two weeks and the making of test-meal estimations in the cases I observed that the galvanic current did control secretion, but not to the extent that the sedative and antacid medicinal measures did. The ratio between them was about 1 to 8 in the way of results achieved, although the neurotic element in the current cases was improved much more than in the medical.

The best results in atonic or sluggish stomachs that I have obtained were by the use of the slowly interrupted faradic current (long spring steel interrupter with a weighted free end) with the positive electrode within the viscera and the external electrode (negative) on the neck, back, or epigastrium. The fast interruptions are not of the same value in producing results in motor disturbances that the slower forms are, and the same rule holds good when the negative pole is within the organ. The faradic current is used to the tolerance of the patient. I have

employed with promising success the combined current (galvanic and secondary faradic) in the same type of cases where there was no existent a sensory or secretory disturbance. The primary faradic is not as beneficial as the secondary is. It must be plain that little good can be accomplished by this method of treatment in dilated stomachs if the dilatation is secondary to pyloric stenosis (secondary ectasia), or has come on acutely, like the paralytic distention of acute surgical dilatation.

The best results from their use are seen in the myasthenic and incomplete atonies which have developed from long-standing errors in eating or drinking, or muscle weaknesses which are concomitant or secondary to long-standing sensory or secretory disturbances. When the muscle weakness has gone on to extreme atony (atono-paralytic ectasia), the results are liable to be anywhere from most brilliant to none at all. It is impossible to foretell in any long-standing atony just what the results from its use will be, but it certainly is worthy of a continued trial in every case, even sometimes in the presence of rather persistent failure. The author has observed cases in which the continued use of the faradic current seemed to be of little service, when suddenly the cases would make a change for the better and the stomach be reduced perceptibly in size, after which the entire picture of the cases improved. Faradism in my hands has served me well in the treatment of neurasthenic conditions of the stomach and intestines, and also in the states of deficient gastric juice secretion (hypochlorhydria, long-standing chronic gastritis), and in pyloric and cardiac incontinence. It is also of service in a few cases of simple nervous anorexia.

The galvanic current is sometimes of signal service in the irritative sensory and secretory conditions of the stomach. The sensory conditions are found in the hyperesthesia, gastralgias, often in neurasthenia gastrica; and the secretory, in gastritis acida, hyperchlorhydria and gastrosuccorrhea. I have observed cases of post-ulcer-irritated stomachs when it was of much value in maintaining comfortable digestion. It must be remembered that because it is a mildly appreciated current, even when much too strong for a safe use in the stomach, it must always be used in weak strengths, 5 to 25 milliampères, and that an accurately calibrated milliampèremeter in the circuit is indispensable.

In the secretory cases, if no motor disturbances are present, the combined currents would be the best to employ, with the negative pole internally; a considerable number of the hyperacid and the hypersecretion cases are benefited in this way, because a more or less destruction of the protoplasm of the proliferated oxyntic cells takes place, thereby allowing of a permanent diminution in the amount of secretion. Care must be taken with this form of treatment, because an internal electrode

readily upon the mucous membrane, and from which a greater millampères of current are coming off, may cause a liquefaction sues at that point and the danger of a subsequent ulcer develop- at site. The safe-to-use positive pole internally has no effect ering hypersecretion, but it is efficient in most cases in diminish- yperesthesia of the mucosa, such as is best seen in the uncompli- es of hyperesthesia and neurasthenia gastrica. In the hyperes- ses in which there is hypersecretion, the use of a pole changer f a half-time administration of first one pole of the galvanic nd then the other.

e the advent of the intragastric electrode in medicine, many n the forms of instrument devised and but few have lived to : test of time for general employment. In the use of such an

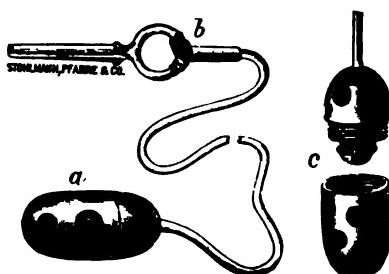


Fig. 73.—The deglutable stomach electrode of Einhorn.

nt, in addition to the essential features necessary, we owe a our patient to employ one that can be quickly introduced into ach or esophagus, and which is comfortably borne by the uring the course of a treatment, which usually takes about tes. It is also manifestly of value to select one that is prac- s strength of construction rather than a toy.

first substantial advance that was made in this was by when he constructed an instrument along the principle of ach bucket and which was comfortable for a patient to keep roat, an impossible matter with the stiff forms of electrodes d since then advocated.

while in this instrument one essential in the electrode was y brought about, another, which was not present in the stiff as added,—namely that it had to be swallowed for its intro- nd this became unpleasant and difficult for most patients.

briefly sum up this matter, I quote from an article of mine introduced a new form of instrument which was both easy of

introduction and comfortable to the patient, and which is the one that I employ (Bassler<sup>4</sup>).

"The intragastric electrodes now in use may be divided into two classes; those which have a narrow conducting cable (the Einhorn, and Ewald's and Lockwood's modification of it), and those which depend on a thick stiff tubing (like a stomach tube) around the wires to give the cable firmness so that the end-piece can easily be pushed into the stomach (Boas', Stockton's and others). The first class comprises the best instruments for practical use, for the latter only magnify such objectionable features as may be found in most of the first group. The matter of irrigation during the time of the passage of the constant currents (possible in some of the electrodes of the second class) is not of much practical value in intragastric work.

"The main objection to the deglutitable electrode of Einhorn is the fact that it must be swallowed for its introduction. This is often a discouraging performance to patients, is time consuming and is not devoid of dangers to the physician (infections and abrasions from the teeth incident to placing the olive far back into the mouth of the patient). I have had patients who could not swallow or would vomit up the end-piece even when the utmost care had been exercised in its introduction. Furthermore, as Lockwood has pointed out, the trailing string of this instrument is a disadvantage, although in my hands not so much of a one as the first mentioned. Therefore, the deglutitable feature is a decided drawback rather than an advantage in the constant use of this otherwise good instrument.

"When a stiff, straight wire (Ewald) or a spiral one (Lockwood) has been incorporated in the cable, the valuable migratory feature of the Einhorn electrode is done away with, and the instrument is rendered uncomfortable for the patient in the pharynx during the course of a treatment sufficient in length of time to obtain results.

"Another objectionable feature to the American-made Einhorn electrode is the thinness of the insulated rubber tubing about the wire. In practice, this rubber is constantly breaking down from wear and tear of use and the teeth of the patient. This objection is minimized to a degree by the thicker tubing to the electrode here shown, a modification now carried into effect in the German makes of the deglutitable electrode. This thicker cable makes no practical difference in the comfort to the patient.

"The new electrode consists of two separate parts, the electrode proper and the introducer. The end-capsule of the electrode (13 millimeters in diameter) is a hard rubber perforated case inclosing a metal ball in which the conducting cable is held. The introducer is the main feature of the instrument. It consists of a spiral wire covered with rubber tubing on which is marked the usual distance from the incisors to the stomach. At one end of the introducer is a stem, flattened on one side, which fits into the metal ball. The flat surface prevents the ball from turning when the instrument is assembled for use. On the off-end of the introducer is a round metal ball of no significance.

"The patient is first made to drink a tumblerful or more of water; this is essential as a conductor of the current from the metal ball in the end-piece to the external electrode. The introducer is lubricated with glycerin, then the electrode (which has been immersed in water) is mounted by slipping the spherical end on to the stem of the introducer, after which one turn of the cable is made around the end of the introducer shaft. The entire instrument is inserted into the patient in the same way as is a stomach-tube. At the desired point in the esophagus, or better in the stomach, the electrode is freed by simple direct withdrawal or by first making one or two short in-and-out movements of the introducer, the cable being free from the hand. The introducer is then withdrawn, leaving the electrode within the patient. It is my custom at this time to have the patient take another swallow or two of water. Care must be taken not to have more than one turn of the cable about the end of the introducer, and it is advisable to free the cable from the hand after the capsule has been delivered below the laryngo-pharyngeal junction.

"At the end of the treatment the electrode is withdrawn in the same way as is the simple deglutitable instrument; that is, the string is drawn upon until the ball end is held at the back of the larynx, then with an effort at swallowing (when the

troitus of the esophagus opens), the end of the instrument is delivered. I have used this electrode several hundred times with success and thus can recommend it as most practical and satisfactory instrument."

All treatments should be given in a fasting stomach, or about three hours after a simple breakfast or one hour before a larger one. Sometimes when there is marked dilatation or gastroptosis, the treatments should be conducted with the patient in the prone position. In other cases, a larger quantity than one tumblerful of water may be employed, and the patient can remain in a sitting position.

Of first importance is the employment of a battery that is capable of delivering all combinations of currents, one in which the rate of electrical flow is easily controlled, one which has a perfect milliammeter, a secondary coil of sufficiently high tension, and a pole changer.

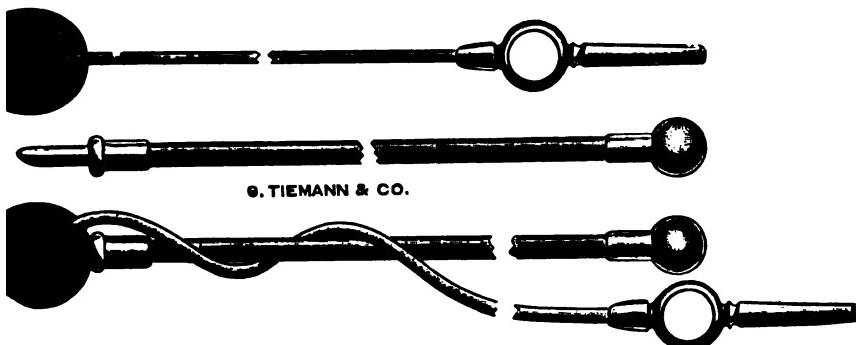


Fig. 74.—Author's intragastric electrode.

It has been my experience that the transformed current from the direct alternating commercial currents, as delivered from wall plates, is too irritating for intragastric work. At the best, the stomach stands but a small amount of current, and only a few battery cells are necessary to deliver a current sufficient to do the work. It is best, however, to provide a battery which has a greater number of cells, so that as they run down from use and time more current can readily be added to make up the shortage. Such portable chemical batteries are supplied by numbers of good manufacturing houses which make medical batteries.

It is best to give the treatments along routine lines so that they will be thorough. To these ends, two forms of external electrodes must be employed: the hand electrode which is moved about, and the large plate electrode which remains stationary covering a large area. The rules that I can give for the employment of these are only general, and naturally would differ in different cases, according to the diagnosis, objects to be obtained, tolerance of the patient, etc.

A treatment should last for from 5 to 10 minutes. The faradic treatments should take a few minutes longer than the galvanic because with the first it is often desirable to treat in addition to the anterior and posterior gastric regions also the spinal and general abdominal regions. The galvanic treatments are more of a local treatment to the stomach itself. The patient being ready, the current is gently turned on. This is then intensified, until in the case of the interrupted current the limit of tolerance is reached, or in the case of the galvanic until the meter points to the desired number of milliamperes. When the combined currents are used, the galvanic should be turned on as mentioned above, and after that the interrupted; it is well to leave the meter on throughout the application of the combined currents, as galvanic currents often intensify during the course of the treatment.

With the external hand electrode attached to the negative binding post, and the patient sitting, the operator stands at the side of the

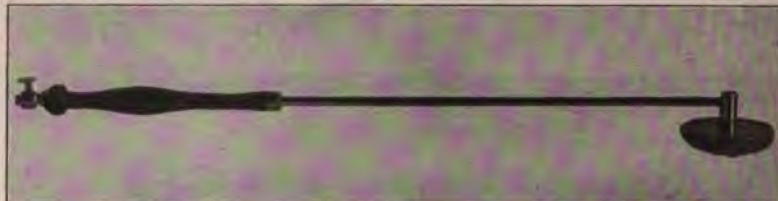


Fig. 75.—Author's long-shafted hand electrode.

person and the wet electrode is moved up and down in the gastric region from the cardia toward the pylorus. The long-shafted electrode greatly facilitates the doing of this comfortably. The small intestine, colon, and sigmoid can next be treated by moving the electrode over these regions. After two or three minutes, the left lower axillary region is treated, and then the current can be made stronger for the back, where the same general movement as was employed in front is carried out. In cases of myasthenia, atony, and deficient secretion, it is well to place the electrode on the sides of the neck (particularly the left) for some minutes. The flow can be alternated, when desired, by means of the pole changer. When there are hypersensitive spiral points at the sides of the vertebra, these localities should receive attention, and in cases of relaxed abdominal muscles the treatment may be finished by securing a series of contractions of the side abdominal and recti muscles—all of which are easily and effectively stimulated and exercised. Care should be taken that the current is not strong enough to be painful, remembering always that the wetter the sponge the greater is the intensity of the current.

When it seems desirable to permit the current to flow to a large external area the large external electrode can be employed in place of the hand instrument. In cases of pains in the back of a reflex nature (loaded colon, autointoxication, gastric neuroses, vasomotor and sensory disturbances of the gastro-enteron, etc.) this method is of much value when the large plate is placed over the area corresponding to the great sympathetic plexuses in the upper abdomen.

Ready-to-procure large abdominal electrodes can be used for this. The author has used pieces of sufficiently heavy Crooks metal, cut in the desired shape and size for the case and over which he placed several thicknesses of a folded wet towel, or, better yet, thick pads made of Turkish toweling. In this way separate pads could be used



Fig. 76.—Hayes' spongiopiline-abdominal electrode.

with each case, and clean ones constantly supplied. A very practical external electrode can be made with a series of rings fastened together and stiffened with wire. An ordinary pot-walopper answers for this, and such an electrode possesses the advantage of adjusting itself to the curves of the body.

In the employment of the single galvanic current, usually from 5 to 25 milliampères in strength, much of the treatment should be given over the gastric regions, front, side and back. The hands electrode can follow the same course as above outlined, and some special attention should be paid to the vertebral region from the seventh to the tenth dorsal, and also the epigastric region. I would caution against the use of a strong galvanic current in the stomach, and would advise the constant moving of the outside electrode, and also advise against the use of the large electrode plates.

I have seen some excellent results with even a very low amount of this current (5 milliampères), using the intragastric electrode as the nega-

tive end. These were cases of long-standing gastritis, where there was probably much thickening in the walls of the stomach (hyperplastic or hypertrophic gastritis). Likewise good results were obtained in cases of persistent hypersecretion where the condition had been of long standing (gastrosuccorrhea chronica, hyperchlorhydria chronica). When the secretion of gastric mucus was increased and was a prominent feature in a case, no benefit was derived in the diminution of it. I believe these results were obtained by the softening, disintegrating, or liquefying effect of the negative current, and quite naturally, on this account, the treatment should not be continued too long nor the current used in too strong amounts. The negative pole stimulates the vasomotor nerves and dilates the lumen of the vessels; the positive is sedative in its action upon the vasomotor nerves of sensation, and controls secretion by causing contraction of the vessels, thereby decreasing the blood-supply to the stomach walls.

It has been my custom to treat patients every second day for two or three weeks, then twice a week for a week longer, and finally once a week until the improvement is permanent. This routine, of course, differs markedly with different cases, some treatments being continued at the every other day interval for a month or more, and others again, when the case is not very pronounced or makes quick subjective improvement, decreased when the latter is apparent.

What some of the beneficial results that are obtained by the intragastric employment of electricity are due to I am unable to say. But that it is a potent therapeutic measure in well-selected cases when an accurate diagnosis has first been made and the proper current employed, there is no question. No doubt most of the results lie hidden in the mysteries of the great sympathetic system, concerning which the scientific medical world still stands in unshadowed darkness. The method is easy to employ (nowhere near so distasteful a procedure to patients as the passage of the stomach tube), and as they soon become accustomed to it and feel the benefits derived, patients return regularly for the treatments.

**Percutaneous Electric Therapy.**—By this method the body is treated entirely from without, with the hope that the current employed will sink deeply or course directly enough within the body so as to effect changes in the viscera. In the mass of literature on hand (most of which is unscientific in its nature) different degrees of statements are apparent, all the way from unwarranted extreme optimism, to just as extreme pessimism. Apparently some of these observers claim results from the use of different modalities too often without the basis of a proper diagnosis of condition and proper conservatism and care

at reaching conclusions. These wide ranges of reports the author will disregard, and give only his own observations.

It is my belief, based on a quite general use of the different forms of electricity in gastro-intestinal work, that what cannot be accomplished by the intragastric or intracolonie use of the galvanic and interrupted currents, cannot be brought about by any of the externally applied forms, whatever may be the sources of their generation. The currents of a circuit nature as they flow from one pole to the other will always take the course of least resistance, and this in the body means the tissues which hold the greatest amounts of fluid or blood. It must be manifest that with one electrode on the epigastrium and the other on the back in the recumbent position, when the stomach sinks away from the anterior abdominal wall, but little or no current would flow through that organ in preference to the better-conducting side walls or liver. This manifestly would exempt the deep-seated pyloric region, and the lung-, heart-, and pleura-covered cardiac end and fundus. Even in extreme distention of the stomach, only a small part of the body of the organ is in contact with the parietal wall (prone position), and the rest of the organ is surrounded by tissue or space to carry off or positively obstruct the direct flow of a current. In the sitting position, and when the forward inclination of the body still further favors it, better results might be obtained providing the organ contains fluid to assist in its transmission through the walls. The same problem is also present with the intestines, but few of whose coils are in contact with the abdomen anteriorly, and even these are covered by the greater omentum. It is my belief that, unless the applying electrode is deeply sunk into a relaxed abdomen, local benefit is only brought about by indirect means or through moral effect. In the examination of many patients who suffer from digestive disturbances one often encounters painful areas that are reflex in their causation. They are found in the back as well as anteriorly, and are the remote nerve-end manifestations of disorder within. Most of them are neuralgic or hyperesthetic in their nature. Ofttimes these areas are markedly sensitive, and the percutaneous use of electricity is a measure of some value in their symptomatic treatment. Among these may be mentioned (leaving out the more general and remote conditions, ulcers and malignant disease), in front, the painful and tender areas of the gastric and enteric neuroses, gastrophtosis, chronic gastritis, impacted flexures and descending colon and sigmoid, disease of the gall-bladder and ducts, subacute and chronic enteritis, movable kidney, mucous colic, etc., and in the back, the diffuse areas of gastric and enteric neuroses, the diseases of the gall-sac and ducts, pains of impacted colon, colitis, debility, renal colic, neuralgia, etc. Among the currents

for these, stands first the galvanic, then the combined, and finally the faradic, using large plates both front and back in all instances. Of service at times is the employment of the sinusoidal current, using two large electrodes, one covering the abdomen, the other smaller and placed in the mid-dorsal region. The apparatus used by me is the Morse and the Wappler machines.

The various forms of static currents are sometimes of use as a general tonic in the neurotic disturbances of the stomach and intestines, particularly when these are secondary to general neurasthenia states. I particularly question the penetration of this kind of electricity even when delivered as sparks, or directly by the so-called Morton wave current. The high-frequency currents employed as spinal treatments are also of some value in the treatment of these general neurological conditions. I believe it was Osler who advanced the thought that, a well-equipped, small-sized laboratory was of more benefit to a physician than a dust-covered static machine. I agree with him fully, and would add, that if the time and expense necessary to keep this same apparatus in running order was employed in becoming familiar with laboratory technique, the study of the various reactions, and microscopic work, the science of medicine would be more rationally, broadly, and logically advanced.

**Esophageal Treatments.**—In the direct treatment of the neuroses the interrupted or continuous currents may be of value. These are seen practically in the general sensory disturbances of neurasthenia where esophageal symptoms are prominent as reflexes from a neurotic stomach, and in the esophageal spasms accompanying hysterical conditions. I have also observed persistent cases of esophageal neurosis of a sensory nature in women at the menopause in whom the use of the currents was of value.

It must be plain that in those cases of esophageal distress caused by gastric disturbances, as well as in the still more general nervous disorders, the gullet symptoms are usually reflex, and any benefits that would be derived from direct treatment of the tube would be more apt to be moral in nature or secondary to the favorable influence of these treatments upon the primary conditions in the general system. Taking such gastric conditions as hyperchlorhydria, in which the constant belching of acid gas and fluids causes irritability of the esophageal mucosa, or the stagnant states of the stomach when the regurgitation is bitter in taste, the best results in so far as the esophageal symptoms are concerned would come from the proper treatment of the stomach condition.

In the electrical treatment of the spasms, however, brilliant results are often seen, providing these spasms are of the hysterical order and occur more or less constantly in the history of the case. In those spasms which come on acutely after a marked indiscretion of diet in a susceptible neurotic individual, both as these are confined to the esophagus proper or else involve the fauces and soft palate, the treatments are of little benefit; in fact, they often aggravate the conditions which naturally would be best controlled by medicaments of a sedative, emetic, or purgative nature, as may be indicated.

In the organic strictures of a malignant nature, naturally no benefit can be derived. The same is probably true of most cicatricial forms; but recently I experimented on a case of this kind with the following satisfactory results: Upon the same principle as the electric treatment for urethral strictures I treated several patients, who, as a

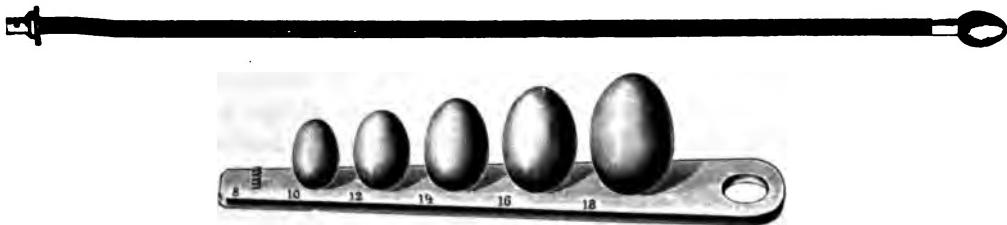


Fig. 77.—Esophageal electrode, which has different sized olives and which can also be used as an esophageal bougie.

result of swallowing strong lye or other caustic solutions, finally developed a stricture. Feeling that some benefit might be derived from the use of the galvanic current I treated them daily, with the negative pole on the stricture and the positive under them, using a large-sized plate upon which they sat. The electrode is crowded as firmly onto the stricture as is thought safe. From 15 to 30 millampères of constant current are employed for 5 minutes at each treatment; the average amount I assume is about 25 millampères. After several treatments the ability to swallow may be perceptibly improved, and a large olive can easily be passed on down into the stomach. Whether the electrolysis of the constant current really helps in bringing about this result I cannot say. I am inclined to believe that it does; and should such have been the case, the method may be worthy of more general trial in some of those desperate and unfortunate cases of obstinate and impassable strictures before resorting to surgery.

Inasmuch as water, as is used in the stomach for the purpose of carrying the current to the tissue walls from the perforated, hard,

rubber-cased, intragastric electrodes, would be of no service when treating the esophagus, the end-pieces of these instruments are made of bare metal. For this reason some care must be exercised that the constant current is not strong enough to destroy the mucosa it comes in contact with; with the use of the faradic current the stiff stem of these instruments is somewhat uncomfortable to patients unless they hold their heads rather far back. The electrode may be slowly run up and down in a patent gullet during the course of the treatment so as to affect the entire canal. The best form of external electrode to use is the stiff Cooks metal plate cut so that it fits over the spine or entire sternum as may be desired.

**X-ray Therapy.**—Because of the brilliant results that are brought about by the use of the Roentgen rays in the treatment of malignant disease of the skin and superficial tissues (carcinoma and sarcoma), one would suppose that in the cases of malignant disease situated deeper within the body we had in this therapy a measure of some practical value. At first, when this was used, some very flattering reports of cases were issued, and this, no doubt, established its more general use and brought about the better knowledge of it that has come in late years. Based upon a rather extensive and free use of the X-rays as a therapeutic measure in a number of cases of malignant disease and other types of gastric cases, I report my observations in the main as follows:—

The X-rays (and no doubt all other kinds of light treatments) are of no value in the cure of gastric carcinoma, sarcoma, and even those slower types of malignant disease following chronic ulcer (*ulcus carcinomatous*). In a few of the late cases of carcinoma, liberal use of the rays from a hard tube may, for the time being, apparently stay the rapidity of a growth. But the cases soon again continue to progress; so doubtless no actual benefits are derived. In the medullary forms of cancer, this is not so liable to occur, and I believe that the systemic symptoms (debility, cachexia, etc.) are made worse by its use; this may be due to a softening of the mass so that there is a greater degree of toxic absorption. Some relief of pains is occasionally brought about for a short time, but this is far short of the relief accomplished by the use of morphine. More frequently the anodyne effect of the rays is but very transitory, and ordinarily no result is accomplished. It is my belief that when the pains are relieved it is accomplished entirely through suggestion, and not by any beneficial effects of the rays on the growth.

In the cases of inoperable sarcoma (gastric and enteric) that I have seen, slightly better results were obtained in the relief of symptoms,

but all, nevertheless, rapidly succumbed to the disease. In all, twenty-two cases of inoperable or recurrent malignant disease of the stomach and intestines were treated by me with the X-rays, and all of them progressed to a fatal ending with but little benefit from the rays alone. Therefore in such cases I have given up its use altogether.

The author respectfully cautions against depending upon the use of the rays in all early cases of malignant disease. My reason for this is that much very valuable time is wasted. The growths always continue, involving the deeper stomach tissues and spread into the surrounding structures, and the organ itself then loses its proper function and the local pains and systemic states ensue with the rapid development of the deplorable picture of late malignant disease. When the diagnosis is made, or when it is most probable that incipient malignant disease is present, surgery offers the best means of therapy, and it is our duty to the patients to persuade them to this course, rather than temporize with other measures until it is too late. Possibly in cases where an excision was performed, and where the indications were favorable against a return, the rays may be used for a while to guard against recurrence. Even here, I have my doubts that they can be depended upon as being of much value, for it is my belief that when the carcinoma cells are still present in the tissues, lymph-spaces, or glands more or less remote from the field of extirpation, the rays could not arrest their proliferation, propagation and consequent tissue involvement. The value of X-ray therapy is too theoretical, and I question the accuracy of the diagnosis in those cases in which brilliant cures have been reported. I have also tried the steady use of the rays directly upon a scirrrous cancer of the pylorus. In this case, a long median incision and a suturing of the stomach to the opening retained the outer area of the stomach within a permanently open incision. The case was rapidly fatal in spite of the daily use of the rays. If, at operation, even an extensive malignant growth is noted and extirpation is too hazardous, a portion of the neoplasm should always be obtained. The reason for this is that the growth under the microscope may prove to be an infectious granulomata (syphilis, tuberculosis), instead of a carcinoma—both of which may be cured or improved by medical means—or the neoplasm may be one of those rare forms of cancer known as an endothelioma for which the medical use of the X-rays may be curative or most beneficial.

As unfortunate as have been the author's results with the use of the X-rays in malignant disease, the very opposite has been his experience with the rays in the treatment of latent and chronic gastric ulcers. I believe that in these cases it is a treatment of value. Just this is so I am unable to say, but there is little question in my mind

it is at least worthy of more general application in these cases, and also in most all benign post-acute ulcer conditions.

I have been resorting to the routine application of the rays in cases of acute gastric and duodenal ulcers after these patients have left their beds for several years, and I feel that the end-results of the medical treatment in the cases have been much better than in the cases in which it had not been used. I am quite sure that the number of cases of half-healed ulcers, spasmodic and irritative states of the stomach are fewer with me to-day than they were several years ago, and this I do not attribute to any improvement in the plan of medical treatments I now employ. I am inclined to believe that the rays stimulate the mucosa to a better repair of the ulcer, and that the resulting scar is not so stiff. It must, of course, be understood that when these patients are under treatment any concomitant condition like hyperchlorhydria or a marked hypersecretion must receive proper dietetic and medicinal attention or the desired results may not be achieved. The rays should be used in these cases as one of the last measures of routine treatment, after the bed, dietetic, and medicinal cures for the acute stage of the ulcer are concluded. With their use, a number of the unpleasant sequels (carcinomatous degeneration, erosion and autodigestion of the scar, marked contractions of the cicatrix resulting in sacculation or hour-glass formation, perigastric adhesions with the surrounding organs, very irritable states of the mucosa, etc.) will probably be lessened.

In the chronic forms of ulcer, and particularly those found in the aged, a resort to these treatments should be tried before the surgical measures of excision or drainage. They may fail as they often do or they may be of the utmost service. I do not advance this as a substitute for excision or gastro-enterostomy, which I look upon as much the better form of treatment, but for what my own experiences have been in the treatment of some of the cases of late acute and chronic ulcers, and particularly in the medical care of cases of gastric ulcer in-older persons in whom abdominal surgery has such a high rate of mortality, or in whom, for general states of health or other disease, operation would be inadvisable.

In the cases of chronic catarrhal disease of the mucosa, forty-six of which were treated, no benefit was derived. Two cases of hyperplastic, three of hypertrophic, and one of atrophic gastritis claimed subjective benefit from the treatment, but this I was never able to prove to myself with the various test-meal examinations I had made in the cases; no doubt it was mostly mental in its nature, although the disquieting effect of the rays may have had something to do with the benefit in the hyperplastic conditions. I have had no experience with its use in

the true neurotic affections of disturbed secretion, motility, or sensation, because I consider many of these too impressionable to suggestion for accurate conclusions. In hypersecretions of a chronic type, the prolonged employment of the X-rays should be tried before operation. In these cases it is not unusual to meet with those in whom marked benefit is brought about, probably by an atrophying effect of the rays on the cells in the secreting tubules.

The essentials for the giving of this treatment are a tube of sufficient hardness to pass the rays deeply into the abdomen and a coil with its accessories, or a static machine of large size. My early results were obtained with the coil, although I feel that one of the high-speed static machines is just as useful in giving sufficient current for penetration. The treatments were given to the patient in the prone position, the stomach always being empty of foods. They were treated regularly every other day unless the skin showed the permanent blush seen before the development of an X-ray dermatitis, in which case the treatments were discontinued for the time being. Most of the cases were treated with the large-sized open tubes of the Mueller type, and those in which just the pyloric region was singled out were treated with the lead glass tubes with the flint-glass window to permit the rays to come through. It has been my custom to first stand a patient between the tube and a fluoroscopic screen and turn on the current until a fair glow with the outline of the spinal column was seen by the rays passing through the abdomen. The quantity of current was then noted, and the patient given like amounts in each of the treatments. In slimmer patients not so much current was employed. The use of the Roentgen rays in the diagnosis of stomach diseases is found in Chapter V.

#### ELECTROVIBRATION.

Having been somewhat discouraged with the results obtained from hand massage and vibration alone in the treatment of the gastro-enteric conditions in which these measures seemed to be indicated, and having obtained on the other hand some satisfactory results from the use of the constant currents intragastrically applied, it occurred to me that possibly in the atonic, low secretory, or mysterious sympathetic disturbances, the benefit from these externally applied physical measures (the currents and mechanical massage) would be enhanced by combining these two and applying them at the same time. Along these lines, to simplify the work, I devised a new vibratode head which would also answer as one of the poles for the constant or interrupted currents.

It was my feeling that by combining these two fair measures of therapy, the benefits of each would be enhanced, minimizing the doubt or failure of results from the hand massage or the percutaneous use of the currents. I feel that I have been moderately successful with this in the treatment of some of the nutritional, neurotic, atonic and catarrhal conditions. I have stated that of the forms of massage itself the vibratory method gives much better results in the deep abdominal conditions than the hand method—it is more effective and directional; and then, because the one external electrode (vibrator head) is sunk deep in the relaxed abdomen, one can be more sure of direct effects from the current as it passes from above downward or *vice versa* than would be the case by the use of the plates or sliding hand electrodes.

In the disturbed states of motility, and in sensory and secretory conditions of the stomach, the results from the treatments were somewhat

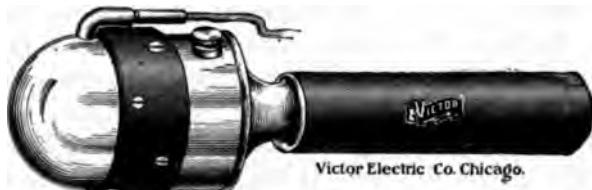


Fig. 78.—Author's electrovibratode, showing insulated end-piece.

better than with the single forms of these physical measures. Often the combination of the constant current with the vibration caused relief of pain and distress in the simple sensory and secretory conditions (this may have been due entirely to the current); and in the atonies, the use of the faradic currents was sometimes quite encouraging (this I believe to be due to a combined action of the two). The best results in so far as the stomach was concerned were seen in those cases in which the gastric disturbance was secondary to the enteric disturbance, for in selected cases of the latter the treatment is particularly beneficial. Taking my experiences as a whole, and stating it briefly, I feel that some of these cases did better than if they had been treated by the generally established older time clinical methods alone. And even if I cannot explain this to my own satisfaction, I state it with a firm conviction that the moral effect of the treatments, or just the dietetic or medicinal results always employed, did not have all to do with it.

Of the clinical cases treated, I observed particularly four cases of chronic membranous colitis of long standing, which, under treatment for from two to seven months, made decided general physical improvement. In two of these, the constipation was markedly relieved; in

another, only moderately so; and in the fourth one not at all. In one of the last two a thin mucous discharge of seven years' standing from the lower colon was stopped, and the quantity of tougher mucus from above the colon was decidedly lessened. Two of the other cases showed less passing of tough mucus, but in the remaining one (a marked col-optosia) there was no apparent difference in this local way. None of these cases were treated at the same time by colonic irrigation (which, in my opinion, is the best single method of therapy for these conditions), but other measures, such as cascara, tonics and so on were also used. I feel that this method of treatment is worth a more extended trial in those more or less chronic cases in which results from electrical and massage treatment have been so few in the past. A case of dilated transverse and descending colon made marked subjective improvement and the gut returned to a more normal size. Three cases of general tardy condition of the intestines (*myasthenia entericus*) were treated; two were entirely relieved, and one in which the condition was due to a depressed mental state showed no improvement. Three cases of neurasthenia entericus claimed and apparently received much benefit from the treatments. Up to the time of writing, I have used this measure, steadily kept up, in 69 cases of ptosis, comprising about all the grades and combinations of abdominal viscera prolapse that are clinically seen. Although none of these showed much change for the better anatomically, 61 of them claimed benefit, and in 63 of these this was plainly apparent in a general way. These, however, were the cases in which I feel that the mental effect worked the strongest, and most of them would no doubt have improved by the method of increased feeding, abdominal exercises, supporting measures, and so on that were also employed. A case of recurrent enterodynia of two months' standing was discharged well; possibly here the galvanic current alone would have achieved the result, but the patient claimed that he felt better and was longer without pains when the slow, deep vibration was given with the galvanism, than when the latter was used alone. It will be plain from the above report that the measure is of more value in the treatment of the enteric affections rather than those confined strictly to the stomach. Summing up my experiences in a broad way I have advanced the following (Bassler<sup>5</sup>):—

"Electrovibratory massage is of value in the therapy of abdominal conditions in all motor, some sensory and a few secretory disturbances of the intestines, both locally and as they may directly or reflexly affect the stomach or other parts of the body; it is a measure of value in the disturbed states of local nutrition of the reachable abdominal organs, and in the abdomen as a whole—its influence here is to better the general state of health and favorably

influence those catabolic and neurasthenic conditions, the origin of which is in the abdominal cavity; it is the best single medical measure we have to-day in the treatment of exudates and fibrous adhesions found about the abdominal portion of the alimentary canal; in those mysterious, tardy forms of intestinal indigestion, and also in the long-standing catarrhal conditions, it can be employed with satisfactory benefit to the patient; it is the best form of percutaneously applied physical treatment we have for abdominal conditions, better than hand massage, vibration, or the externally applied battery currents; its use should always be preceded by an accurate diagnosis, since in some of the conditions of the gastro-enteric tract it might do positive harm (malignant disease, ulcers of any type, acute catarrhal and suppurative states); following a plausible indication for its use, it should be employed by the physician himself, or under his immediate direction, suitably combining for the case massage and the properly selected current; and, lastly, it should then be employed with a consistent and, if needs be, long kept up effort to accomplish these ends."

The vibrator I would recommend is the long-shafted, motor-run type, capable of delivering the long, slow stroke. The currents I used were the slow or fast interrupted faradic, the straight galvanic, the combined galvanic and faradic, and the interrupted galvanic. The faradic up to the tolerance of the individual was used in those cases in which muscular or general stimulation was indicated; the galvanic, of from 5 to 10 milliampèremeters, plain or interrupted, for its sedative effect on the nerve terminals in the gastro-enteron, either through an effect on the sensory or secretory disturbances, or both; and the combined, a combination of the above was used for the more complex conditions. In the last instance the faradic current should always be turned on first. The vibrator head was usually the positive pole and the treatments lasted ten minutes.

The patients were treated prone on a long, heavy table, with their knees raised and separated. Toilet powder was used on the abdomen so that the vibrator would slide easily; this did not interfere to any appreciable extent with the passage of the current and rendered the treatments more pleasant in every way. Effort was made to retain their abdominal walls lax so that the instrument could be sunk deeply. The plan was somewhat different in the various cases according to the massage routes of the organ or organs treated—colon, small intestines, stomach, abdominal walls or entire abdomen—and also according to the character of the currents and the choice of the anteriorly applied poles (whether positive or negative).

**RADIUM THERAPY.**

With the hope that the topical application of radium may serve of benefit in the treatment of cancer of the esophagus or stomach, Einhorn devised a capsule (into which the radium is placed) to which is attached a string to insure its return from the stomach at the termination of the treatment. The instrument is introduced the same as the stomach bucket, and is left in the stomach about an hour for each treatment. The esophageal instrument has, instead of the string attachment, a tubing and mandrin to push it well down to or into any stricture of the gullet that may exist.

The deviser of this appliance at the time stated: "In regard to the action of radium in cancer of the stomach, I have treated too few cases to form a definite conclusion. It seems to be of palliative benefit. In cancer of the esophagus I have had more experience with this mode of treatment. I have applied 0.25 gram of radium (curie 20,000 strength) daily in about 20 cases and have achieved an improvement in most of them—the improvement could usually be observed after a week's treatment; at times, earlier."—"The results obtained were very satisfactory."—"In the methodical application of radium we have the means to influence favorably the course and seat of the disease and to retard its progress."—"This mode of treatment is certainly destined to play an important rôle in the therapeutics of cancer of the esophagus and deserves to be tried on a large scale and in a thorough manner." (Einhorn<sup>6</sup>).

Up to the present I have assiduously treated with radium a number of cases of gastric and esophageal carcinoma and must confess to a very general failure in them all. In the stomach cases absolutely no benefit was derived that I could learn. Of course, these were all late cases in which but little could be expected from any form of treatment, but I have felt that if there was any palliative virtue in radium it might first be as an anodyne for pain; in this it was barren of results beyond what might be termed a moral effect. I feel that should any physical treatment be employed in these cases the X-ray, because of its greater diffusion and its more positive effect on cutaneous growths of a malignant nature, would be the better means to employ, although I have my doubts of its value. Of late, however, very large doses of radium have been used over the abdomen, the exposure lasting for several hours. Some benefit in an analgesic way has been obtained in quite a few cases.

In some of the cases of esophageal disease, relief of pain and better ability to swallow were evident; in the remaining the results were negative. Whether the benefits were brought about to an

by the action of the radium itself on the malignant growth I cannot state. In some it was apparent that the careful crowding down through the stricturing mass of the radium capsule at each treatment brought about a more permeable passage with resulting ability to swallow fluid or semi-solid foods. I feel that the relief of pain and subjective improvement for the time being were due to this mechanical dilatation alone, and not to the action of the radium. Of late I have given up the use of radium in carcinoma of the esophagus.

Only second to the dread of a slowly developing suffocation is the subjective horror of being unable to swallow foods. These esophageal cases usually come to us rather late when this fear is well established. The radium capsule with its introducer is an ideal, small-sized esophageal bougie, one that occasionally makes its way through a rough and hilly growth better than does the regular esophageal bougie, which has a stiffer whalebone staff (on the same principle that a filiform will worm its way through a firm and uneven stricture of the urethra which is impassable to a stiffer form of instrument). Of late I had constructed for a case of malignant disease of the gullet a small ivory esophageal olive on a rather pliable thin steel wire, and used this with as much relief to the patient as I had obtained in the two cases mentioned in whom I had employed the radium capsules. Upon this case mostly I base my belief that the reported results from the radium are brought about mechanically rather than through any specific action of the radium, and those cases are usually such pitiful ones that relief in this way might easily lead one into making deductions beyond those that are warranted. In malignant disease of the esophagus the early establishment of a gastric fistula for the purpose of maintaining nutrition still offers the best results that can be given to a patient. It is hoped that the new operation of esophagogastrectomy will finally become helpful in cases of malignant disease of the cardia.

#### MECHANICAL MEASURES OF SUPPORT TO THE ABDOMEN.

This form of treatment for affections of the gastro-enteric canal aims to raise and sustain those of the abdominal organs that are lower in position than they normally should be. In clinical observation, these organs in the order of the frequency in which they are observed are, the stomach, small intestine, colon, kidneys, liver, and spleen. The prolapse may be of a single organ (gastroptosis, nephroptosis); any combination of two or more (gastro-enteroptosis, gastro-nephroptosis); or a rather complete picture of ptosis of most of the abdominal organs which possess mesenteric attachment.

Of late years, the subject of ptosis has awakened a widespread interest, and more attention is being paid to the details of these orthopedic measures of treatment than heretofore. Rightfully this should be so, for now many cases of this nature, which in former years were classed among chronic affections, are not only immensely relieved of their subjective symptoms, but are positively and materially assisted to a complete relief and permanent cure. To these ends, abdominal belts of various kinds, adhesive-plaster strapping of the abdomen, the use of pads to directly support the displaced organs, and corsets have been employed.

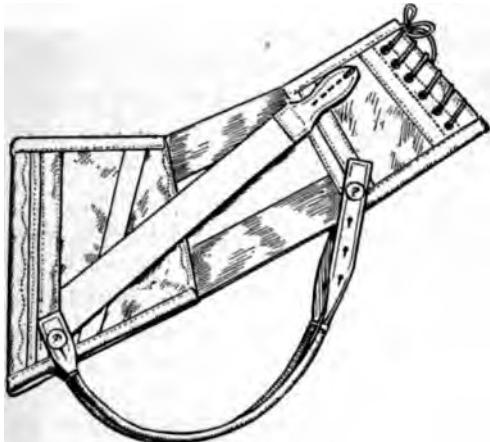


Fig. 79.—Author's belt, showing mesenteric straps in position. The body of the belt is constructed so as to take a very low purchase in front and the highest possible point in the rear, which is generally gauged by having the top of the back of the belt fit well into the waist line. The front and back are made of inelastic material; the mesenteric strap and side are made of elastic webbing. The body of the belt must fit snugly and evenly, with the perineal straps (which are indispensable) just taut enough to keep the belt from riding. For men with flat abdomens, 3 or 5 vertical steels, concaved toward the abdomen like the corset, and placed upright in the apron front, are often of value.

So many varieties of these have been advanced by different observers, and the indications for their use and the best type of support to employ for an individual case being so different, the author will confine himself to his own ideas in their selection and construction, and a rather complete offering of those with which he is the most familiar.

The usual abdominal bandage that is employed for the purpose in the great majority of cases, carries one main fault—it is built too level in the transverse way to properly sustain the organs. These same belts must be worn low over the hips to have them fit snugly enough to keep them from riding, and thus they are placed about on a level with the sacral region and consequently simply bind or compress the

abdomen backward. It must be plain in this event that no organs are raised until the anteroposterior diameter of the abdomen has been sufficiently decreased so that the organs will be pressed upward from this pressure. This makes it really a long way upward, and in many medium, and all thin subjects, my X-ray observations have proven that it is only a poor way at best.

Now, the object of a belt is, in addition to being a circular support to the entire abdomen, to act as a sort of artificial mesentery so as to support the laxity of the natural supports within and the abdominal wall without.

This uplift is not possible unless a belt is constructed with these ends in view, namely, built low in front and as high as possible in the rear (the upper border of the back of the belt should fit well into the waist line). It is obvious that no belt which is loose on the patient would serve to be of much or any value, and this brings us to the cause of the lengthy debate on the value of belts.

It has been somewhat of a surprise to me, after a diagnosis of prolapse has been made and the wearing of a belt advised, that more attention to the details of its construction, fit, and what it is to accomplish in the desired way are not given. Given a case in which the wearing of a belt would be proper, do we give full justice to our patient when we leave this matter to the surgical appliance maker alone and then await reports from the individual in the way of derived benefit? Surely no physician would be thus satisfied in a case of hernia in which he advises the wearing of a truss. No, he would request the patient to return with the truss, and when properly adjusted insist upon him sitting with his knees far apart and during an effort of straining or coughing observe if the truss properly prevents the gut from coming through the ring under these favorable conditions for its doing so. Why then is this any less important in the case of an abdomen, on the surface of which no indication is present of prolapsed organs. A hernia is a visible thing, but a ptosed organ is just as much so by fluoroscopic observation. We are the ones, with our skill in diagnostic measures, who must stand monitor and be responsible; for if this simple observation was observed more generally among the profession, belt wearers for these conditions would not so commonly flit discouragingly from belt to belt in search of relief and more benefit from the wearing of them.

Manifestly, it must be understood, that even the best forms of abdominal bandage cannot serve the purpose in all cases. In fact, they are only serviceable in a percentage of women, and in a somewhat large percentage of men (because men have too narrow and shallow an abdo-

men in an anteroposterior way). To serve best, we must have a large and bulky abdomen to deal with, so as to make the belt fit snugly and have enough bulk of tissue to take advantage of for making pressure. It is this bulk that renders possible to women late in pregnancy the benefit from such supports. To order a belt for a small or flat abdomen simply soothes the conscience, without taking into consideration the all-important fact that, whatever the belt and however well it may fit, this abdomen will slip around on the inside of the girdle and thus it will bring no results. How could the mechanical benefits of such a garment be pro-



Fig. 80.—Author's belt on a woman, showing the apron front with the bent steel, double elastic sides, perineal straps and garters.

duced in many of the cases of gastrophtosis that we see in young women and men, long-thoraxed and abdominally slim as they usually are? That brings us abruptly to the point of where it is best to use the abdominal bandage.

The ideal case is the one of splanchnoptosis which follows successive pregnancies—the so-called Landau cases, because first described by him. These women, because of laxity of the abdominal walls, usually present an abdomen which in profile is more or less concave above, and prominent below the umbilicus. Many of these women are of the poorer classes of foreign-born people, who are busily engaged in household duties and the rearing of large families. Most of them but seldom wear a corset of any kind, and thus suspend over

their already low abdomen several thicknesses of skirts which serve to drag it down still farther. Then, again, there is seen the rather thin and poorly nourished woman, sometimes of the better classes, who presents a more or less complete picture of abdominal prolapse. With the sagged stomach, she usually also has a coloptosis with one or both movable kidneys, gives a history of a long-standing colitis, an obstinate chronic constipation, and a history of dyspeptic disturbance of years' standing. This woman, although much poorer developed than her sister of the first type, still has a bulky abdomen, somewhat smaller than the Landau, but yet very prominent for her weight and build. With her, freedom of movement of the body and abdomen above the belt would be of advantage in the general way, and thus it would be best for her to wear a belt, if only temporarily. Lastly, are the men of all types who, because of their sex, cannot wear a corset, and in whom the only choice lies between an adhesive plaster belt, with its disadvantages, and a belt depending upon certain extra measures, like the use of abdominal pads and so on, to assist in the support. In those very thin men with flat abdomens the transverse belt made of all elastic webbing on the order of Lockwood's (which I believe to be the best of any) is often the only style of support we can employ. And it might also be stated that these men, built straight as they are through abdomen and hips, are the only examples in which the transverse belt is of advantage. Of late, I have succeeded in fitting some cases of marked degree of ptosis in men, usually of the coloptotic type, with a belt of the form shown in the illustration, in which the front apron is fitted with concave steels like those in the front of the corset I use, excepting, of course, that these stays are shorter than in the corset. When there is sufficient concavity of steels, the so-called mesenteric straps are done away with.

**Adhesive Plaster Strapping of the Abdomen.**—Of the methods of strapping that will serve to good purpose are particularly those suggested by Rose and Rosewater. I am somewhat inclined to favor the Rose belt, for the reason that it is simpler and answers the purpose admirably. It has been my experience that the ordinary adhesive plaster when constantly worn is too irritating to the skin, and that it soon becomes stiff, wrinkled, and thus most uncomfortable. Therefore, I favor the zinc oxide facing (which is less irritating) on mole-skin (which is softer and more pliable). This plaster in proper widths and five- or ten-yard lengths is now readily procurable from manufacturing houses.

In the selection of this belt, the plaster is cut in lengths long enough to overlap across the back. It is then folded end to end, and cut from the lowest edge in front to the upper part of the ends of the strip, as in the diagram.

This makes three pieces of plaster; the large apron for girdling the body (A), and two long lower pointed strips (B). Piece A is applied first by sticking the pointed end as low on the front of the abdomen as possible, and then swinging the small ends as tight and as high as possible to lie flat around the body in the rear, one overlapping the other across the back. The lower edges of this piece should not include the crests of the ilia. The smaller strips are next applied low from the hypogastric region, across the inguinal, over the iliac, and across the back over the under piece.

This form of belt when properly adjusted is a valuable appliance. It possesses the advantages of being quickly put on any type or size of patient without much preparation, measurement or expense. It is also a most tight-fitting support—a sort of inelastic new abdominal wall. In my experience, however, its use cannot be depended upon as

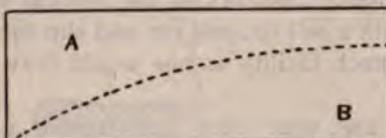


Fig. 81.—Cutting of the plaster.

a support much over two weeks, when it must be removed and a new one adjusted.

It possesses some very marked disadvantages which cannot be obviated. When continually worn, it becomes locally very uncomfortable and irritating to most skins. No matter how carefully we adjust it, from the movements of the body the edges of the plaster curl over and adhere to the underclothing. It soon becomes wrinkled, board-like, and worthless as a support, after which the discomfort and trial of taking the plaster off and the putting on of a new one are anything but pleasant to many persons. Then, again, the person is deprived of his bath while the appliance is on. Consequently its employment is not altogether satisfactory. But this much may be said for it, that when a quick relief from symptoms is desired for just a short time, or until a more comfortable support can be made, its employment is well worth consideration. It has also been my experience that, because of the difficulty in securing a good fitting belt for male patients with slim abdomens, it may serve to advantage for them for continued use, and may be kept up until improvement has been brought about, although generally the belt presented is better.

**Pads.**—Pads of various kinds, shapes and sizes are used as accessories to belts and corsets. Naturally, the details in construction of all of these need not be entered into here. The common use that they are put to is for the purpose of holding the kidneys in better position. They are usually worn fixed to some part of the side of the belt, or are slipped loosely inside of it, depending upon the tight fit of the circling garment to hold them in place.

On the whole, the use of most of them is a presumption upon the intelligence of both the physician and the patient. It requires no experience to observe, or stretch of the imagination to deduct that they are worse than useless. They are rarely twice in the same place, and besides giving no benefits in any direct way, harm can come from their use. I have never seen a kidney or stomach held in place by their use, and if the pad becomes displaced to above the organ it would serve to drive it still farther down.

One of the amusing incidents of the medical tenacity to their use, is to see a patient with a belt on, pull out and slip back a so-called kidney-pad with about as much facility as one would draw and return a watch into a vest pocket.

Of occasional use with men and women patients who cannot afford to purchase good made-to-measure corsets, is a large-sized pad which comfortably covers the entire lower abdomen so as to increase the pressure or support offered by the belt or a straight-front corset. A pad I have used for years under these circumstances, and one which occasionally gives signal results, is made of a thin but sufficiently stiff leather to give it form, and on which, on the abdominal side, is a cushion of curled horsehair covered with kid.

The lower edge of this pad fits into and just above the arch made by the anterior superior spines of the ilia, Poupart's ligament, and the symphysis pubis. The upper border extends to just below the umbilicus, and the lateral edges are well over to the sides of the abdomen. The cushion is thicker at its lower edge than above. Such a pad is soft and pliable, and readily adjusts itself to the body and outside support. It is very comfortable to wear, although it is warm for summer use. It can be fastened securely inside the belt, or one-half of it can be attached to one side of the corset. Usually, however, with most of the common corsets if properly laced and with a tight-fitting belt it remains nicely in place.

**Corsets.**—A properly made, well-fitting corset always offers the best means of support for women. It may be said that while the wearing of waist-compressing corsets is responsible for the production or aggravation of many of the cases of ptosis that we see, another

corset especially constructed for the purpose and not any less fashionable than the first can be made and comfortably worn to correct it.

Many of the present kinds of ready-made corsets, like shoes, are made for sale and fashion rather than for necessity. The corset on a form in the show window is admired, the fashion plate consulted, and then many of our stylishly inclined women change the contours of the body to meet this new fashion. An inch or more girth to the waistline in some women brings terror to their minds, and thus a corset is selected and worn which is smaller in this dimension than it rightfully should be, with the inevitable result of an abdominal compression which first exerts itself upon the liver, interfering with its function; from that organ the pressure is transmitted to the kidney, pressing it out of its nor-

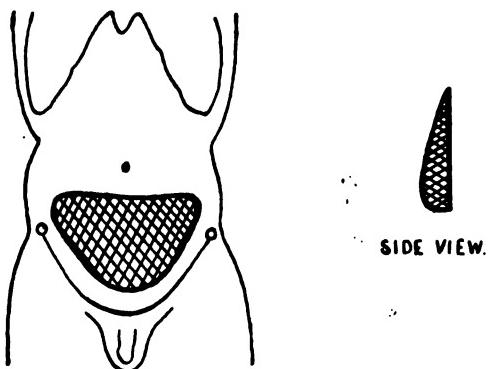


Fig. 82.—Large abdominal pad to be held in place by an ordinary straight-front corset or belt.

mal position and to the stomach forcing it downward, distorting the pyloric end and causing dragging sensations in the epigastrium, increased gastric fermentation from stagnation of its contents, and neurotic disturbances, intestinal derangements, constipation, etc.

A corset of the proper kind, should be long enough to come well down over the pubic bone and crests of the ilia, should not come up high on the thorax, and should be loose enough above the umbilical line to allow for full play of the lungs and the organs immediately below them, all of which rise and fall with respiration. A tight fit at or about the epigastric region interferes with the normal change in size and position of the stomach when it is distended with food. Pressure at the lateral sides of the lower thorax may safely be exerted to shape the garment and give support to the kidneys when these are low, but this narrowing should be allowed for by a corresponding increase in the anteroposterior diameter of the garment when it is on.

As women differ in their faces, so they differ in the shape and dimensions of their bodies. Therefore it is, that ready-made corsets which are made up in numbers all the same way, like ready-made garments cannot serve our purpose. These garments should always be custom-made, and accurately fitting to the body.

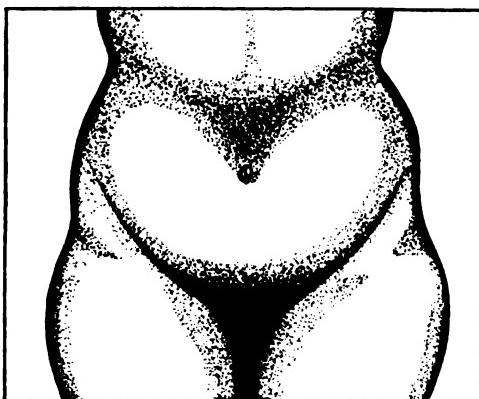
The best corset of this kind is the one built on the lines suggested by Gallant, which are simply those of a perfectly fitting garment.



Fig. 83.—Author's corset on an extreme case of gastroptosis in a medium-sized young woman in whom the corset raised the pyloric portion of her stomach eight centimeters with almost immediate relief of the gastric distress after eating, complete relief of constipation, and marked subsequent benefit to her general health.

This corset, however, is a too generally tight-fitting garment, which in my clinical experience can be improved upon when we have a definite function for the corset to perform,—namely, the support of definite abdominal organs that may be prolapsed. My X-ray examinations of the lower border of the stomach before and after this type of a corset was on, have proved this to be the fact. But in the average rather stout woman, where just a single kidney is loose and the stomach low or where there is a slight general prolapse of the abdominal organs,

ers well. It is a stylish-looking garment and women like it. It has been somewhat objectionable to me to have the corset fit as over the hips as Gallant advises. This binds the lower body and the rather flabby subcutaneous tissues found in many of these Furthermore, I am not in favor of the strings being much before the corset is put on, because of the difference in the of approximation of the back borders of it at the successive s—thus differences in the degree of support. This is not a very objection however, since after a little attention to it most women he garment about the same each time.



84.—The double, wing-shaped, light portion of the abdomen shows the area that is reduced by the concave front of the corset.

nust be evident, in those primary cases of single organ prolapse the young unmarried women of slim and medium build where a flat abdomen to deal with, that a straight-front corset shaped abdomen would not be of much service in raising the organs. It nswer well as a wall against which, during such an act as deep on, the abdomen would be held back. Then again, if this style t is pulled very tightly around the hips, so that it violently com all of the external soft tissues, a uniform pressure is exerted to a point in the interior of the abdomen. At this level there would nerally exerted horizontal decrease in all of the diameters, and would serve to raise the viscera. But is such a degree of cir stial pressure wise, when corsets especially made in front can be d which would raise the organs better, be just as stylish in their and curves, be generally loose so that deep abdominal respiration e or less abdominal exercise is possible, and which (most impor-

tant of all) can be constructed to fit the varying degrees of depths of the abdomen so that the extent and direction of uplift can be accurately exerted according to the requirements of the individual case?

Such a type of corset was advocated by the author (Bassler<sup>7</sup>), and further use since its introduction (over 10,000 women up to the time of this writing) has established its practical value, its general comfort and definite support to prolapsed organs, and its desirability from the viewpoint of fashion. It is the daily remark of concerns and individuals who fit these women with one of the many kinds of corsets now offered for sale, that benefit is being derived from the use of their particular form of

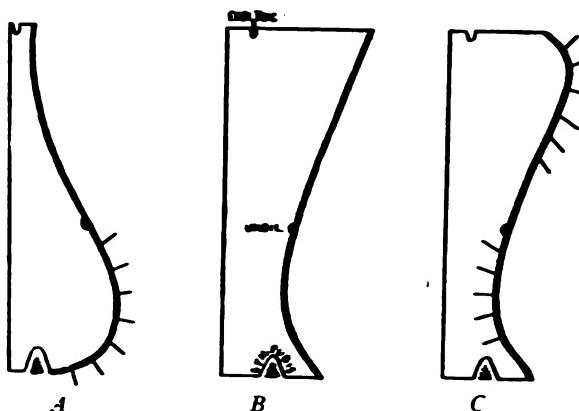


Fig. 85.—Schematic plan, in profile, of the author's corset and belt with the steels in front. *A*, represents the type of low-sagging abdomen commonly seen in cases of splanchnoptosis. The radiating lines show the directions in which the pressure of the viscera is exerted on the walls. *B*, The corset, when closed, showing the concavity below the navel and the straight line above so as to further sustain the raised viscera. *C*, The pressure lines of the corset (below), and the resulting bulging of the upper abdomen (above).

corset. Taking all cases of ptosis together in which no complications exist, the satisfactorily treated ones comprise about two-thirds of them all, although, even in these, X-ray examination with the corset on fails to show that a perceptible degree of uplift to the stomach or colon is exerted. This leaves one-third of the women who receive no clinical or subjective results from their use, and it is in these that my corset has been useful. I therefore argue, that, if the latter are improved by it, all of the first two-thirds also would be, and this has been my constant observation.

With women who have a large, low-hanging abdomen, the con-caving of the corset is not required, because here you have sufficient tissue to use in making upward pressure upon and raising the viscera—

ordinary made-to-order, straight-front corset answers sufficiently. In the medium-large abdomen it is always advisable to use a corset concave front. If we examine many of those pendulous abdomens in front (standing position of the woman), the bulging is noticed in double wing-shaped, each wing extending from the linea alba to the umbilicus upward toward the flanks. This is especially obvious in the extreme cases of generally relaxed parietes, and even in the



Fig. 86.—Author's corset with medium curvature on a case of gassitis with palpable and movable right kidney in a very slim woman, was 5 feet 11 inches in height and weighed 110 pounds. The pyloric stenosis of her stomach was raised five centimeters, with relief of her symptoms and a gain in her general health and weight amounting to 17 pounds in the first 2 months, and 17 pounds in 5 months.

Here there is not much diastasis of the recti to allow for extra fullness to give the abdomen a globular shape.

In this type of case, because of the fascicular and interfascial muscle stretching (also the fascia), caused as it is by the longitudinal pressure from the organs within, the abdominal muscles are less atonic. This is plainly evidenced by the poor control, and power of contraction of the muscle planes. The concave corset overcomes this prominence, and, bending the muscles backward, permits

of a better circulation through them, and a retraction and rearrangement of the fibers, so that after a few months of wearing the corset the abdomen is not only generally smaller at this level, but often a distinct flattening is observed below the navel when the abdomen is viewed in profile. All this desirable change is due to the pressure effects of the lower part of the corset in front.

For the very slim, long-thoraxed women its use is most beneficial. No other style of corset or appliance serves nearly as well to sustain the prolapsed organs. Their abdomens are too flat to derive any benefit from belts (adhesive plaster or otherwise) or straight-front corsets. By the concave steels their protosed organs are held steadily in place,



Fig. 87.—Showing the position of the body during the hooking and lacing.

relieving the subjective symptoms, and causing a usual gain in weight—most desirable object in all of these cases.

Before a corset or other form of support is applied, an X-ray picture, as Pfahler has suggested,<sup>8</sup> should always be taken, followed by another after the support is on. This is necessary in all instances so as to be sure that the garment is performing its intended work. Should it be noted that the uplift is not as complete as it should be, steels of deeper curving can be put into the front of the corset. In cases of nephroptosis and general visceroptosis the X-ray examination is not of much service, and we must depend more upon the relief of the subjective symptoms and general improvement in health.

All garments for these cases should be put on with the patient in the recumbent position with the knees flexed (see Fig. 87). This permits the organ to sink backward and upward to higher planes within the abdomen, and is similar to the principle of first reducing a hernia before putting on the truss. In the case of the corset here advised, it is placed around the body, the patient being recumbent. The garters are then

fastened, and the lower eyelets closed. While still in this position, and after forced exhalation, the rest of the hooks are fastened in place, and the lower laces tightly drawn, after which the woman rises from the bed and completes her dressing. Under no conditions should the corset be laced while the patient is standing or sitting, because holding the abdomen up with one hand or drawing it upward after the lower hooks have been adjusted does not elevate the organs to any practical extent. Still, the corset, through the fastening of the first hooks may be adjusted in the standing position, but the rest of the procedure must be done with the patient recumbent.

Extensive experience on the part of a corsetière with the making of this corset is not essential for deriving satisfaction from it. My experience has been that anyone who is capable of making a properly fitting, made-to-order corset suffices. All that is necessary is to put into the front of this loosely thoraxed corset, instead of the straight steels that are ordinarily used, stays that have been sufficiently bent to suit the case. This bending of the steels is usually accomplished by first detempering them by heat, and then setting them, when still hot, between three uprights set on a base (nails in a small board) so as to give the proper curvature. An extra rotary twist along the long axis will make the garments fit closer above and below. For the best results, I would advise the use of three degrees of curvature—slight, moderate, and marked. These, with the simple, straight steels for corsets for stout women, will serve for all cases. The physician should advise just what degree of curvature the steels should have rather than leave this to the corset maker. This matter is judged by a general observation of the size and shape of the abdomen, a consideration of how much curving is necessary to elevate the organs, and X-ray observations with the garment on to see that the necessary degree of uplift is being brought about. If this should not be sufficient, still more deeply bent steels can easily be put into the garment until this essential result is accomplished.

Among the features in the construction of this corset that the maker must keep in mind are: that it is high behind at the top and low in front at the bottom; that it fits the wearer tightly around the pelvis from the crests of the ilia down and decreases gradually in pressure to the upper edge (with the corset properly laced and the woman on her back, the garment should be loose enough so that both hands may go down inside it to the navel); that it is considerably incurved at the waist line at the back and sides, but shows no waist curve in front; that the front has as many long steels as possible and that these are uniform in curve, but deepest above the pubes; so that with corsets laced in front, the lacing from the navel down to the lower edge sh

tight, while that above the navel be as loose as possible (two laces required); and that deep diaphragmatic breathing should be possible without the corset above the iliac crests pressing unduly upon the lower ribs. It is best for the corset to be laced in front, with the hook and eye steels on the left (stomach) side. In stout women the garment may be skirted.

#### HYDROPATHIC AND THERMIC TREATMENTS.

By these are meant the external application of water of various temperatures and dry heat or cold for the treatment of digestive disturbances. Of these, for the purpose of relieving pain and inflammation, the time-honored Priessnitz Umschlag, or wet pack, is the most useful of measures. I have often used it with success in persistent gastric distress accompanied by extreme nervousness. In my experience, when methodically kept up, it is a very useful application in controlling the pain of acute gastric ulcer—in fact, I may say the best form of external application in these cases that we have.

The technique of it is very simple, and many times it can be carried out without the assistance of a trained nurse. A folded, small-sized sheet or towel is soaked in cold water and wrung out so that it does not drip. This is wrapped smoothly around the body, is covered by a sufficiently wide piece of oiled silk, or other impervious cloth, over which is bound another sheet or towel to keep it securely applied to the body. It is important, to prevent the bed-clothes and those of the patient from becoming wet, uncomfortable, and therefore dangerous, that the oiled silk or cloth used for the purpose be wide enough to extend well over the edges of the wet towel. It is not necessary to change this dressing often, usually not more than two or three times in the twenty-four hours. The inside cloth as a rule remains wet from the local stimulation of the skin, and, generally, when it is taken off it steams like a cloth which had been wrung out in hot water. This sweat bandage, as I am pleased to call it, has a sedative and anodyne effect, sometimes almost as perfect as a small-sized dose of morphine and often lasting longer and, of course, less objectionable in every way.

Complete warm baths and warm packs are sometimes of value to control nervous and muscular tensions and restlessness. These, with the special hot sponge bath, are all most useful measures to induce sleep in many of the insomnias that are found present in gastric affections.

The cold douche or bath has an excellent tonic effect upon the nervous system, particularly when those treatments are preceded by a few minutes of active exercise. The addition of common salt to

the water in the proportion of from 9 to 14 pounds of sea salt to 50 gallons of water is additionally exhilarating and is the best form of cold bathing in those whose neurotic disturbance of the vasomotor system prevents proper reaction from the plain water. The morning salt rub is also of value in poorly nourished cases. Naturally, such special hydropathic treatments as the Scottish douche, etc., cannot be carried out in hospitals or homes, although with a patient sitting in an empty bath tub alternate hot and cold applications of water to the spine for five or ten minutes is often worth the while. They are of much value in the treatment of the more general neurotic conditions, and in digestive disturbances which are secondary to them. In cases of this kind, a lengthy sojourn in a well-ordered sanitarium, where these treatments, stricter hygiene, better air, etc., are readily at hand produces good results in many patients. Still, some of these hydropathic measures can easily be carried out at home, mornings or nights, in those cases which are up and about during the day.

Important aids also are the forms of hot application for the relief of acute pain. Of these, linseed poultices are sometimes worth a trial, but my preference, for sanitary reasons and considering the comfort of the patient, is the folded wet towel with the hot-water bag over it. When the weight of the bag (which should never be more than one-third filled) is uncomfortable, and when we wish a prolonged action from the moist heat, the electric water heater is of much convenience. With it, a small quantity of water in a bag can be kept at an even temperature of about 135° F. These heaters usually work equally well with both the direct and alternating currents, and are inexpensive to run.

According to Fleischer and Penzoldt, the application of local heat to the gastric region hastens the emptying of the stomach, and this, of course, is a valuable state of affairs when we wish to control the total time of disturbed sensation of pain and secretion. I am inclined to believe, with Puschkin, that the application of heat favors increased hydrochloric acid secretion. On two occasions when treating acute gastric ulcers, the recourse from the ice bag to the poultice increased the burning following the taking of fluid foods, but not the actual pain in the stomach. In some of those resisting and also in bad cases of acute ulcer in which we are employing rectal feedings to save the stomach, the cold applications or the sweat bandage is the better procedure. This is so because rectal feedings reflexly stimulate gastric juice secretion, and these added to the direct stimulation of heat, when there is no food or alkalies present in the stomach to neutralize this

free acidity, may somewhat retard the healing and increase the gastric symptoms.

Special forms of poultices, such as starch, bread and milk, yeast, etc., possess no added advantages over the simpler methods. Mustard plasters over the stomach are often of signal service to quickly control the symptom of vomiting in acute cases providing this symptom is direct from some condition of the stomach. When the vomiting is continuous, the use of a mustard plaster to the epigastrium followed imme-



Fig. 88.—Kommerell steam pot with author's insulated handle. The cover of the pot is securely held down by the bar and screw. At the left of the cover is seen the cock for turning the steam into the pipe and handle. To the right is seen a safety-valve. The handle consists of an inner metal tubing capped by a blunt head, in the center of which is a small opening. Around the tubing is an air-space and then the insulated substance, which does not get hot during the passing of steam. The small points seen on the handle are metal tacks to give the hand a better purchase.

diately by an ice bag is of much value. The turpentine stupes are not of much use in the acute gastric distensions with gas. In the intestinal flatus, particularly of the colon, they are of benefit. When it seems permissible, a drop or two of refined spirits of turpentine on sugar may be used in a gastric condition, or a dram or more in hot water delivered into the colon will stimulate more motility in and evacuation from the bowels than the same substance applied externally. Great benefit, too,

comes from the use of 30 grams of alum dissolved in a pint of water, and left in the lower bowel until it evacuates itself.

Ice bags, or quickly changed compresses, are of service in the control of pains, hypermotility, hypersensation and secretion. It is often impossible to foretell which of the two thermic measures, cold or warm, will answer best in the way of comfort to the patient. They both bring about the same results, but in different ways; one by contracting the superficial vessels, the other by dilating them. When there is no special contraindication to the use of one of them, a few hours experimenting will generally prove which would be of the most service.

In cases of distress or pain in the stomach for whatever reason, the use of live steam as an external application offers one of the best routine therapeutic measures for its relief. For this purpose, I use a Kommeral pot with an insulated handle in preference to other devices. The best form of treatment is to have an attendant apply the steam by holding the end of the handle about four inches from the body, the application not begun until sufficient steam has accumulated in the vessel to escape from the safety-valve. A towel should be used on the patient's legs and feet to protect against the drip from the handle. The application is continued over the gastric region, axilla and back until the skin is red, after which a towel soaked in cold water or a needle cold spray is applied for a moment or two. These are again repeated for about ten minutes. Such applications may be made once or twice a day until relief is established.

#### ACTIVE EXERCISE AND OTHER HYGIENIC MEASURES.

From a curative as well as a prophylactic standpoint against return in many of the gastro-enterological affections, are observances of the simple matters of hygiene and mode of régime. To those who live in country districts, blessed as they are with a life truer to nature than are our city denizens, such advice is not so often essential or necessary. But they are important to those living in our great cosmopolitan centers, artificial as such a life must necessarily be in the way of constant application of the mind to matters of business, the small amounts of proper outdoor exercise, many social functions and eating of heavy food, late nights, poorly ventilated apartments, the hasty eating of day meals, and the intemperate use of alcoholic drinks, coffee, tea, etc., all of which have a direct bearing on the causation of many gastric disorders.

Along these lines it may be said that the daily use of the muscles in work, outdoor games, or gymnastics, serves as an aid to more com-

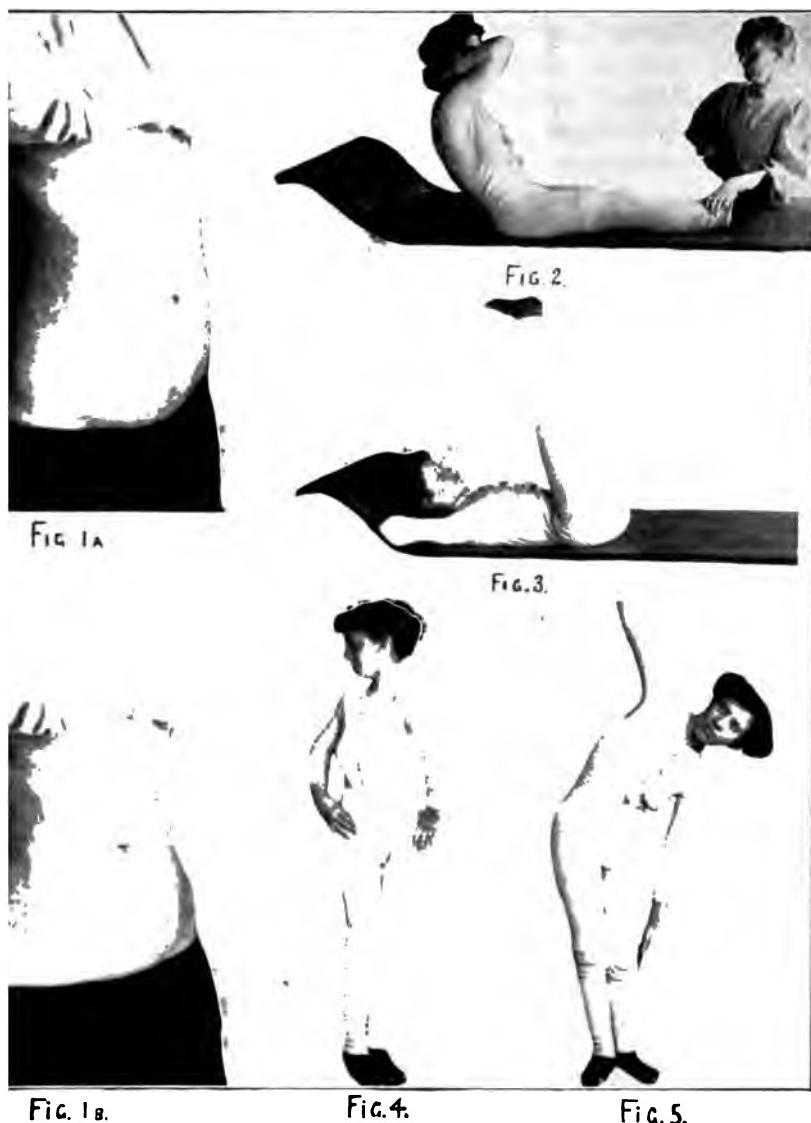
plete metabolism and digestion. In the sedentary indoor avocations, regular physical exercise is an all-important requirement. Morning dumb-bell or weight exercising for five or ten minutes followed by a cold sponge steadily carried on, as well as brisk walking evenings, demands but little outlay of time for those who are steadily engaged. My advice has often been the purchasing of a cheap dumb-bell manual, and the performance of all of the twenty or more movements daily. The exercise drill of the U. S. Army "setting up exercise" answers well for the routine case, especially if this is done conscientiously each day, followed by a shower and about fifteen minutes' general massage. On holidays, the resort to golfing, rowing or long country walks is diverting and health giving. Tennis only sporadically engaged in, is much too strenuous for the ordinary city individual, although with the average woman player, who engages less actively, this is not so to the extent that it is with men. Automobiling and yachting are not as valuable as the more active sports.

Care must be taken, on the other hand, in instances of neurasthenic, atonic, and asthenic conditions, that over-indulgence is not engaged in, because the resulting physical exhaustion often causes impaired digestion for the time being. In the atonic states of the gastro-enteron and abdominal walls, the simple constipations, etc., the forms of exercise which bring actively into play the trunk and abdominal muscles are of value.

Where there is persistent anorexia (not due to organic disease), high loss of albumin in the feces, improper or incomplete conversion (indicanuria and associated and resulting general conditions), poor oxidation and assimilation of foods, katabolic disturbances, and neurotic circulatory conditions, all of these are improved by exercise, fresh air, and change. The manually hard-worked husband and the mother of the home often require rest, fresh air, and diversion, while their languishing, late-breakfasting brothers and sisters in gilded residences require the same, with active exercise in addition. Lower temperatures in living rooms in the winter, fewer gas stoves and illuminating jets in the homes of the middle classes, better-ventilated sleeping rooms in those of the poor, more open windows during the night, and the general health of city people would be better, neurotic disturbances less common, and gastric disorders fewer.

In cases of visceral prolapse most excellent results in the curative way have come from systematic carrying on of abdominal exercises. Naturally, it must be expected that but little benefit could be gained by only a short course of treatment—say, of only a few weeks. Time and again, I have observed these cases continue for months with

PLATE LIV.



Abdominal exercises employed by the author.



apparently no definite benefit, when suddenly, almost in a day, some mysterious change takes place, in which the subjective symptoms fade away quickly. I do not believe that this is accomplished by the exercises alone (high caloric feeding, support to the abdomen, attention in medical ways have much to do with it), but it must not be overlooked that in many of the instances of gastrophtosis, nephrophtosis, etc., in women who have not borne children and also in young men, there is poor power and control of the abdominal muscles. In the Landau cases one would almost expect it, relaxed and flabby as the parietes generally are.

The exercising not only develops the abdominal muscles to a marked degree, but patients gain an immense control over them. This causes their closer application to the functions of life, breathing, power in defecation, and equalizing the circulatory pressure of the abdominal cavity as a whole. The muscular walls soon thicken and strengthen, and this means better support to the organs within. The exercises have a beneficial effect on the organs in the way of toning them up by increased circulation. This not only helps them locally, but assists in the way of better function in the complex process of digestion, improving the general health of the abdomen and bringing about better vital conditions of the body.

When symptoms of digestive disturbance once ensue in cases of ptosis, they are liable to be more or less chronic in their nature and difficult to relieve permanently. Immediate relief of acute conditions is easily brought about, but how common are the cases which have run on with more or less distress in the digestive canal until they are taken in hand in the systematic way of steady attention. In accomplishing this, the abdominal exercises are of the utmost value, are strong factors to complete and continued relief, and are also of value as prophylactic measures during post-partum to guard against the development of relaxed abdominal walls following pregnancies.

The system which I have advanced (Bassler<sup>9</sup>), and carry out generally in all of these cases consists essentially of five exercises. The first (Plate LIV, Fig. 1) is a voluntary exercise performed by the patient. In this the patient directs her attention to her abdomen and endeavors to contract all of the muscles at the same time, with the ultimate object of flattening all of the lower zone of the abdomen below the umbilicus. In most cases, in women particularly, this is somewhat difficult in the beginning, but when persisted in, eventually they gain perfect control of the muscles of this lower section. This tends to raise the organs within, and strengthens the wall in the part that usually bulges the most (permitting of descent), and is the most valuable of the exercises. For best results the movement should be slow.

and deliberate. The second (Fig. 2) is the raising of the body to a sitting position, the feet being held down or placed under a low piece of furniture with the patient lying on the floor. The hands should be clasped back of the neck so that the full brunt of the exercise falls upon the recti. The third (Fig. 3) is the raising of the lower extremities to a vertical position, or, better still, the toes be made to touch the floor above the shoulders. In this, when completely performed, all of the muscles are brought into play. Fig. 4 represents a twisting motion of the lumbar region of the trunk, like the movements of the Oriental dancers, the feet and knees being together, and the hips held from turning. In this the three side muscles are exercised. The last movement (Fig. 5) is a rocking motion from side to side, the hands made to touch the leg below the knee, the feet in contact on the floor, the knees together, and the elbows held stiff.

These movements are performed mornings and evenings in as little clothing as possible. Each one separately is continued until just short of exhaustion from that particular one, when the next is begun. With the exception of the fourth and fifth, they can be carried out in bed. This makes them of service during late post-partum, and they are not detrimental to the end processes of uterine retraction in any way. After the person is about, the standing exercises can be added.

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## CHAPTER XIII.

### Physical Methods of Treatment in Gastric Disorders.

(Continued.)

#### APPARATUS AND TECHNIQUE OF LAVAGE.

For the purpose of stomach lavage the syphon forms of apparatus answer best for general use. The ones ordinarily employed are the simple forms of long stomach-tube and funnel which possess the additional value of being readily procurable and convenient to carry about.

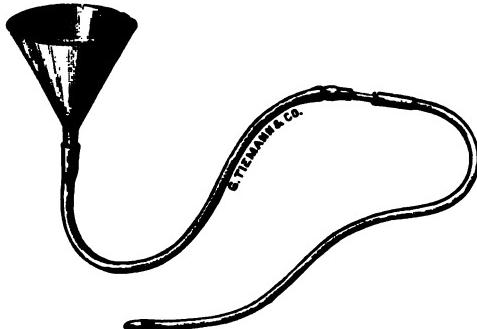


Fig. 89.—Lavage apparatus.

The funnel that is commonly supplied with the above and Fried-b's apparatus is rather small, and, being made of collapsible rubber, flattens in shape. For these reasons it is better to use a glass hard-rubber funnel of about 250 cubic centimeter capacity, a glass e having the preference in that when the funnel is raised over the ad the rate of flow of its contents can be observed. After the tube introduced, the funnel is held slightly above the level of the stomach d the lavage solution poured in from a pitcher until between 250 and 10 cubic centimeters have been delivered. When the flow hesitates e funnel should be raised until this is re-established, at which it is immediately lowered again so that only a gentle inflow takes place. /ith a funnel of the size mentioned, about three funnelfuls are safe d proper to deliver at a time. Just before the last few cubic centi-

meters of fluid are about to leave the funnel it is quickly lowered to a basin on the floor, after which syphonage from the organ takes place. With successive elevations and lowerings of the funnel the stomach may be cleansed, which is noted when clear water runs off.

Besides the simple form of syphon stomach-tube apparatus mentioned above, one may make use of the one which has a rubber ball about half way from end to end. This is practically the Friedlieb apparatus and possesses the additional value of having handy an accessory means to insure success in the procedure. When the return flow stops, as often happens from kinking of the tube in the stomach, non-immersion, or obstruction of the apertures by food, after first pinching the tube on the distal side, the compression of the bulb will correct these so that the flow will be re-established.



Fig. 90.—Syphon stomach-tube (Friedlieb's apparatus).

The objections to the above forms of apparatus are that a second person is required to manipulate the tube and pour the solution, and in those who are not accustomed to the tube that the procedure is liable to be performed with difficulty in the way of keeping the tube properly *in situ*, or that the patient's garments and the floor are soiled with the solution. When lavage is being regularly carried on with a single patient or with a number of persons, the Leube-Rosenthal method not only eliminates some of the above objections, but is much handier.

This method depends upon the use of a jar or bag for the purpose of holding the solution, and a Y-tube with pinch cocks to regulate the flow either into the stomach or from it. With the cock on the outlet tube of the jar closed, the irrigating jar or fountain bag is filled with solution and the detached stomach-tube is then passed and the outer end fastened to one arm of the Y-tube. By closing the cock on tube *a* and opening the one on tube *b* the solution runs into the stomach, and when sufficient fluid has been delivered the lower cock is opened and the upper one closed. In the return of the fluid it is better to open

ver cock before the upper is closed, because at the moment that f them are open the solution from the jar, running directly to sin below, initiates a syphonage through the stomach-tube continues after cock *a* is closed and until the organ is empty. nd person is not required to manipulate this apparatus (I have tients who could manipulate the cocks themselves) and the ages of this method are many to the more commonly used hand

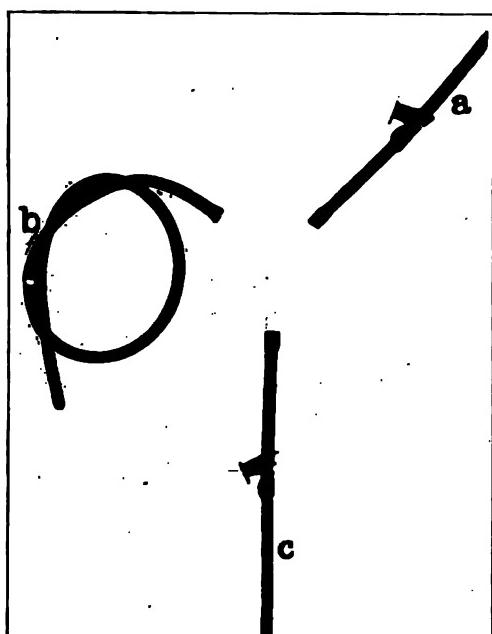


Fig. 91.—Leube-Rosenthal method of gastric lavage. *a*, Tube leading n the irrigator jar to the glass Y. *b*, Stomach-tube. *c*, Drainage-tube ing to basin on the floor.

tus. In the first place the attendant with one hand can control cocks by standing at the side or rear of the patient, while the arm is about the neck of the person and the hand of which is ; the stomach-tube in place or manipulating it in and out as : required.

having a stand holding two jars side by side, two solutions used in the lavage, one for the purpose of cleansing the stomach as an alkaline solution of soda bicarbonate or lime water, and er for the special medicaments such as silver nitrate, hydrastis, antiseptic solutions. A four-armed glass communicating tube

may be used with all tubes attached at the same time, or with the Y the outlet tube from one jar can be taken off when the first jar is empty and that from the second attached.

Experience has taught me that it is wisest to use graduated glass irrigating jars or large bottles with an outlet near the bottom. In the double stand I employ, the first jar has a 3000 cubic centimeter capacity and the treatment jar a 1000 cubic centimeter. In the average case at least 2000 cubic centimeters of solution are necessary to cleanse the stomach, and 3000 are usually enough to make sure of this. More solution can easily be added to the jar if the return is not clear from 3000 cubic centimeters, and less than the total contents of the jar may answer. Not more than between 250 and 500 cubic centimeters should be run in at a time, and note should be made that the effluence

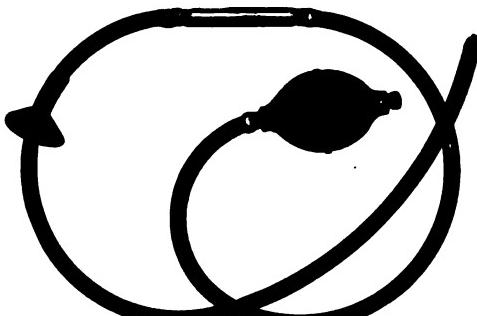


Fig. 92.—Chase apparatus.

nearly corresponds to the affluence. For cleansing the stomach it is desirable that the affluence should occur just below the cardia, and when the effluence is desired the tube be pushed further down until the return takes place. Considerable solution is always lost by passage into the duodenum.

Occasionally it is advisable, for patients in whom a course of lavage treatment is indicated and who have become accustomed to the use of the tube, that the home employment of some form of apparatus be advised which is possible of manipulation by the same person. In these instances I have found that the Chase apparatus answers to good purpose, both for the alkaline lavage and for special solutions. To employ it, the solution is placed before the patient in a large basin, and by means of the hand ball submerged into it and the pinching of the tube while the ball is being filled and then releasing the pressure on the tube and placing the thumb in the inlet the solution is driven into the stomach. After three or four bulbfuls have been delivered, the

is drained off into a vessel on the floor. A second basin may be used instead of the above, for special solutions.

The so-called gastromundator may be used instead of the above, is more difficult to clean. In this apparatus the in and out controlled by changing the position of the bulb. This apparatus answers well for the small amounts of solution that are used purpose of examining the contents of the empty stomach, such as gastric cells, pus, blood, tissue and food particles, etc.

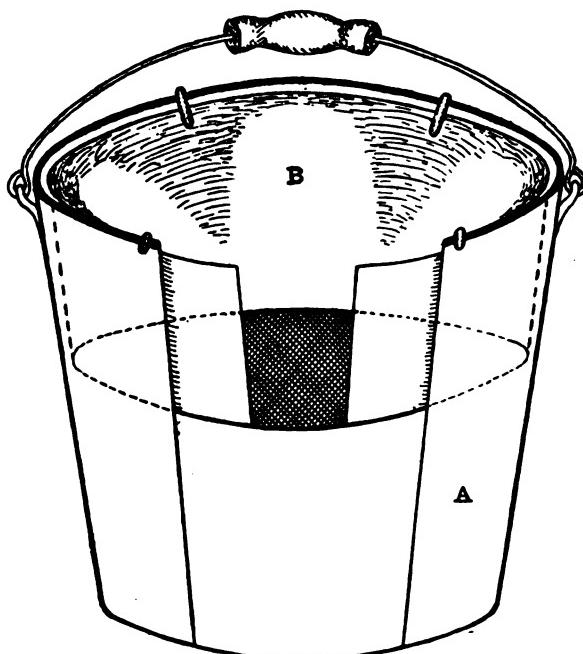


Fig. 93.—Author's sieving pail for straining lavage water. *A*, Ten-gallon pail. *B*, Portable sieving can with a floor of wire screening having four wires to the inch, and four hooks above to hold the can in place.

For the purpose of straining the return wash water from the lavage, the author recommends the use of the sieving pail shown above. The particles sieved, the noting of which are of value in the diagnostic and therapeutic way, are pieces of tissue from the gastric glandular system, food of the various solid kinds, and mucus. In large amounts of tissue particles, because of their small size, being mostly colorless and few in number, are very liable to escape detection unless collected.

Most often they occur as very small flaky pieces, too tiny for collection, and they may be incorporated in mucus and then not be

seen. Their significance being great, they should be examined microscopically, and, if large enough, by the microscope after dehydration, hardening, cutting and staining.

The recognition of states of delayed motility and dynamic obstruction at the exit of the organ is best made by observing the time it takes for the various kinds of foods to leave the stomach. The universally employed procedure of observing whether stenosis exists by washing out the morning stomach after a heavy meal ingested the night before, and the six, seven, eight, and so on hour extractions of the mixed meal for the purpose of diagnosing the existence and degrees of submotility makes the use of the sieving pail of value in the technique of lavage. To the above may be mentioned the fact that, even in the hands of skillful manipulation, particles of tissue detached from the stomach in the process of lavage are not infrequently met with, and thus I advise its use on all occasions of lavage. Bassler.<sup>1</sup>

The apparatus is very simple, consisting merely of an ordinary enameled ware 10-liter pail, into which is fitted a straining can which is made to set snugly into the upper part. The can is made of metal (preferably brass or tinned sheet iron) with hooks above to hold it in place. The floor consists of a brass-wire mesh having 80 wires to the inch. This screen stretches across the pail at about one-third the distance from the rim to the bottom, and is of strong enough texture to stand handling without breakage. This apparatus can be made up less expensively by using an ordinary pudding pan large enough so that its flange will set on the top of an ordinary pail or jar. The mesh is of the kind that is supplied in sieves that are used for sifting grain, sand, etc. At the end of the lavage, the can is taken out and the mesh surface inspected, after which it is cleansed by allowing water to run through it from the under side.

Hospital practice has taught me that there are three kinds of cases in which the rather constant use of the stomach-tube is called for: 1, the postoperative gastroduodenal dilatations, in which the frequent cleansing of the organ is a measure of much therapeutic value, and is essential; 2, the intestinal obstructions, in which the constant cleansing of the organ minimizes the degree of toxic resorption, so that the case is a better operative risk when the laparotomy is performed, and thus is a desirable procedure; and, 3, those of septic peritonitis, in which the gaseous distention of the peritoneal cavity and the paresis of the gut crowd the stomach into the left dome of the abdomen, and in which cases to allow the drinking of water in the large amounts these patients pitiously cry for causes an increasing of the intraperitoneal pressure, and still to give

them cool water by tube which can be immediately drained out again is a most humane act.

In each of these three kinds of desperate cases the suffering of the patients is usually intense, and when the frequent passing of a stomach-tube is added to their distress their misery is deepened. Still, the use of the tube is urgently called for in them, it having to be used every hour or so. For these cases a method of constant drainage of the stomach is offered which answers perfectly, is comfortable and painless, does not require the frequent passing of a tube, and which has the advantage of having a tube always *in situ* for the drainage or delivering of fluids into the stomach.

This consists of a small-calibered stomach-tube made sufficiently stiff for easy delivery into the organ by way of the nose, nostrils, pharynx and down, this tube in size being 23 F or 15 A and 150 centimeters, or 60 inches, long. A marking on the tube 61 centimeters, or 24 inches, from its lower end shows when the latter is in the stomach and lying well along the greater curvature when the marking is at the nostril. The openings are like those of the Boas tube, namely, two in number, one on either side and arranged one above the other, both being rimmed with velvet eyes, and the extreme end being closed. A rather thin-walled, small-sized bulb is supplied to cleanse the tube should it become obstructed, a length of tubing beyond it to give further length for syphonage and attachment to a glass funnel, instead of rubber, so as to give weight to the lower end, that always is submerged in the water in the basin.

The introduction is made with the patient on the back. The tube, lubricated with glycerin, is passed down through the nostril on the side of the bed at which the basin stands. When the proper level in the stomach is reached for easy ingress and egress of fluids, the tube is bound in place by means of a tape or string making a turn around the head, over the ears, and tied at the occipital region; or a short tape with plasters on the sides of the face to hold it. The outside length of the apparatus permits of a reach to a basin of water, the upper level of which should be situated about a foot below the back of the patient or on a level with the mattress; a syphonage to the floor can easily be gotten by adding a further length of tubing from the bulb to the funnel, although this is rarely necessary.

It is surprising how comfortably this apparatus is borne. The majority of patients will lie perfectly at ease, can talk and even swallow, and not a few who have experienced the benefit from the frequent lavagings possible by it—every fifteen minutes if necessary—will fight against its removal. The taking it out for cleaning is not essential during the short time its use is called for, and need not be done. When, he-

there is doubt as to whether the stomach contains solid particles of food, it is wise to wash the organ in the usual way with an ordinary larger-sized stomach tube before this apparatus is installed. Fluid foods and medications may be introduced through the tube, a stopcock somewhere on it being necessary for their retention. In many cases when drainage is sought for, just to raise the funnel out of the water is sufficient to drain the organ without the addition of water through the tube first, and it is not unusual to see fluid from the stomach trickling down the sides of the funnel into the water as fast as it had accumulated in the stomach. In the peritonitis cases, the cool water may be delivered into the stomach to allay the thirst and quickly drained out again.

#### **INDICATIONS AND SOLUTIONS. CONTRAINDICATIONS.**

The indications for lavage are diagnostic and therapeutic. The matter pertaining to the diagnostic will be found in the description of the different test-meals and their examination, and the therapeutics in connection with the various stomach disorders. A brief résumé of the latter might not be amiss in this connection and may serve some practical purpose in this very valuable and still much abused therapeutic measure.

Therapeutically, lavage of the stomach is indicated when some definite reason for its employment exists, either in the way of the removal of irritating and decomposing foods and their products and bacteria, or the treatment of the organ for some manifest condition—not just because the patient is a "dyspeptic." In the first group may be mentioned the cases of pyloric or high enteric obstruction of all forms, the removal of decomposing foods in states of fermentation such as are seen in the butyric acid type of chronic gastritis and the lactic acid type of malignant disease, for the quick removal of swallowed poisons, and intestinal regurgitations such as occur in ileus. High degrees of dilatation secondary to obstruction (in so far as the relief for the condition is concerned) are surgical cases, although relieved by lavage. Primary atonies and duodenal kinking are medical in the way of special dietetics and all medical measures excepting lavage in the great majority of cases.

As a procedure of special treatment in addition to the above, lavage is of signal service in many of the gastric disorders. In chronic gastritis when an increased secretion of mucus is present, the procedure liquefies and removes the adherent mucus and stimulates the glandularis to a higher acid-enzymotic secretion. In this way the motor mechanism of the organ is toned to a more active pitch and

the condition of gastric digestion generally improved. For these results, in addition to the stimulating effects of the water itself, the alkalies (soda bicarbonate 4 tablespoonfuls to 3000 cubic centimeters, or lime water 90 cubic centimeters to 3000 cubic centimeters) answer best. After the use of the alkaline solution, a solution of the fluid tincture of hydrastis (15 cubic centimeters to 1000) or the fluid extract (4 to 8 cubic centimeters to 1000) prevents the excess mucus secretion better than any other measure. Late in the treatment, should the normal hydrochloric acid secretion be low, pure hydrochloric acid (6 cubic centimeters to 1000) may stimulate a higher secretion and is the most efficient antiseptic to employ. In chronic gastritis, when all of the stomach digestive secretions are absent and even if mucus be present in the organ, no benefit comes from the use of lavage as a stimulant; the reason for this is because the gastric cells are so altered by pathological process, or even shed from the tubercles and lost, that but little can be expected from lavage, and thus the dietetic, medicinal, and hygienic measures answer best in the treatment.

In low gastric juice secretions (hyposecretion which is usually accompanied with hypomotility when not organic or malignant in nature) the hydrochloric acid, sodium chloride (5:2000) and 1:10,000 silver nitrate solution may, for a short time, serve as an efficient stimulant to the mucosa. Proper dieting to meet the digestive capacity and still represent a caloric value beyond the requirements of the individual's daily demand (so that the patient can overcome the sub-nutrition that usually exists), with local and general tonics and hygienic measures, answer best for the more permanent relief. In excess gastric juice secretions (hypersecretion, which may be accompanied with hypermotility, and in gastrosuccorrhea) harm is done by lavage. To this, however, in practice there are two notable exceptions. The first is in those in whom an excess acid secretion exists and but little or no gastric mucus is present. These cases, and they are common, receive subjective relief of the gastric distress by the employment of the silver nitrate solution. It acts as an irritating stimulant to the epithelia of the stomach, and as the mucus content raises, even when the HCl secretion remains the same or increases from its use, subjective benefit is acquired. In a large number of these cases I extracted test-meals and aspirated the empty organ during the treatment to note in what manner this benefit was brought about. Excepting the mucus factor mentioned above, and the removal by the lavage of such gastric juice as exists in the organ without food to bind it, I think that in those who were permanently benefited this was due to an induced catarrhal process in the upper

cells of the gastric tubules from the silver nitrate solution, thereby depriving certain cells of their full or partial secreting function. On the other hand are seen cases, and they comprise the majority, in which the HCl secretion always remains high and even increases from the use of the solution, and these are the ones that usually return in a few months for a new course of treatment when only the silver solution lavage had been used in the first instance. With them it is generally observed that the gastric finding of low or absent mucus is as evident as it was in the first analysis. Therefore it is, that the constant use of bland and unirritating foods as low in the proteids as consistent with proper nutrition, the hygienic measures, and more normal mental routine of life in the way of business, home and associations, accomplishes the best results in the end. The second exception is that of the irritative form of gastritis known as gastritis acida. In this the use of the alkaline lavage solutions, together with the dietetic and other indicated measures, answer excellently. Care, however, must be exercised that the lavagings are stopped when the mucus content is controlled, which I may mention is very variable in each instance and usually most liable to return unless the person stringently adheres to the other special treatments.

Lavage of silver nitrate solution may answer to good purpose in chronic ulcer, particularly when more or less stenosis of the pyloric extremity causing retention exists; although here surgery offers the more lasting and satisfying results. It is of signal service in post-operative dilatations of the stomach in the way of removing the large quantities of irritating fluid that usually collect in the organ and also as a muscular stimulant; in these instances the alkaline or the same with tincture of nux vomica dissolved in rather warmer water than is ordinarily employed are of the most service. As a procedure lavage is often of value in the treatment of such symptoms of gastric distress as anorexia, pain, nausea and vomiting, and in these instances the alkaline or normal sodium chloride solution answers well. It is also frequently successfully employed in disturbances of function and diseases of the intestine and of the liver, in conditions of abnormal blood mixture, and in the chronic states of intoxications from renal disease—for example, in uremia; in these plain warm water or the alkaline lavage answers. For the routine lavage, the solution should always be comfortably warm to the hand, remembering that several degrees of cooling takes place in the pouring and in the passage of the fluid through the tube.

Among the contraindications for lavage are those for the use of the tube which will be found described elsewhere. To these may

be added the few instances in which the attendant distress is too severe on the individual, and those who from the extraction of body heat, or when the lavage is practiced during the day from the extraction of foods and the cessation of digestion, become weak and prostrated after its performance. Gastric lavage at an improper time is much more exhausting than when the stomach is empty. The best time is in the morning, before any food has been taken, for in addition to the stomach being positively empty, the vitality is higher and the nervous system is calmer after the night's rest, and because the lavage then cleanses the organ for a day of better digestion. Evening lavage, however, may be practiced in instances of stagnation of food. In these cases the cleansing of the organ before retiring often makes possible a better night's rest. Both morning and evening lavage is usually inadvisable because the patients soon lose strength from extraction of fluid, nourishment, and body heat, and if persisted in long enough may be the cause of distinct degrees of exhaustion.

Excepting in cases in which the diagnosis of an ulcerating carcinoma, old ulcers of the stomach, or that of spasmod closure of the pylorus are most probable, the return of more or less bright blood in the water is a contraindication for the continuation of the washing. In the above-mentioned exceptions the blood is usually more or less altered and even in clots of a bright color. In unexpectedly met with bright blood the tube should immediately be withdrawn because the hemorrhage is usually due to trauma, to capillary congestive states of the mucosa, varix in the esophagus or stomach, or the existence of an unsuspected ulcer. Lastly, it may be mentioned that Ewald recommends the use of ice-water lavage when slight hemorrhage exists, even if this is from an ulcer. Lavage with a solution of copper sulphate (3:1000) is specific in instances of the green fungus and pellicle in the stomach.

#### GASTRIC DOUCHE. SPRAYING AND INSTILLATIONS.

The gastric douche is used for the purpose of therapeutically influencing the gastric mucous membrane. Its efficiency as a procedure depends less upon the style of douche tube that is used than it does upon the character of the solution and the pressure under which the water is delivered. Although the ordinary Ewald tube, which is used for both simple lavage and douching, answers well for douching in a few instances, a higher pressure can more safely and conveniently be exerted by tubes which have only small-sized apertures at the outlet. The Ewald tube, and the douche tubes of Rosen-

heim and Einhorn (page 119) possess the disadvantage that the outlet and return of the water takes place from the lower end. Thus in the process of douching it is essential first to withdraw the end of these tubes to just below the cardia, and after a certain amount of water has been delivered into the stomach it is necessary to push

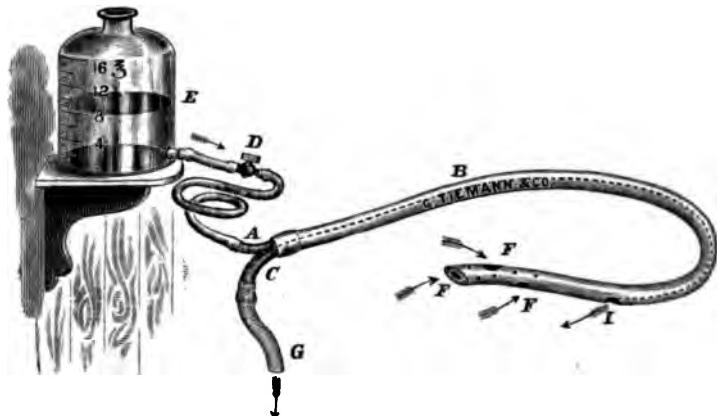


Fig. 94.—Hemmeter's double-current stomach lavage-tube.

the tube down to the collection of water and syphon it off before douching can again be carried on.

The tube which Hemmeter has devised obviates to a certain extent the feature of water collection, but it can hardly be considered as a douche tube. It answers better for lavage, although for cleansing the organ, because of its relatively larger size, it is not superior to the single



Fig. 95.—Turck's recurrent gastric needle-spray or douche.

tubes. The double tubes are more difficult to keep clean, and when ~~the~~ pressure of influx is beyond the force of gravity on the outlet accumulation of water in the stomach generally occurs, and thus too large amounts of water for safety are very liable to accumulate; these are factors against their use.

The tube that answers best for simple douching is Turck's so-called recurrent gastric needle spray. With this tube the inlet can be held stationary below the cardia or in the fundus, while the return tube extracts the accumulated fluid from below. The objectionable accumula-

n of fluid in the organ during the douching (mentioned above) can th this tube be obviated to a great extent by the patient sitting on a her high stool and having a length of outside tubing extend to the or so that a strong syphonage force is exerted. Even with this it is ially desirable to stop the inflow at times and allow the outlet tube to pty the organ. In my experience with this tube it is best to introduce fully into the stomach, then turn on the inflow and withdraw the tube ckly until the end of the inlet section is in the gullet (noted by the ow being much reduced or possibly stopped altogether). The tube is n slowly reintroduced until a good flow begins, and held at that level il the procedure is terminated.

It is true that for rather constant therapeutic use the douching es have but little advantage over the lavage tubes of Ewald or

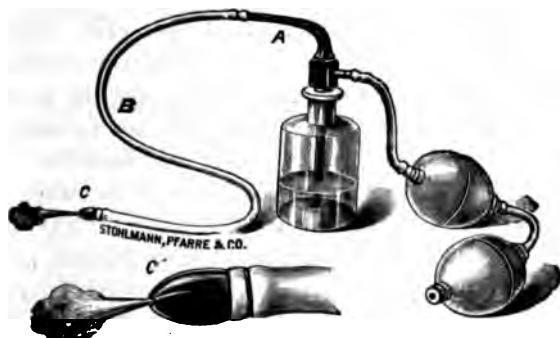


Fig. 96.—Einhorn's gastric spray.

as. But in selected cases of hypomotility, in slight atonies, and posecretion the douche tube can bring about stimulating results the organ, and thus for these cases its use should be retained after rior washing can be discontinued. In addition to the solutions men ed above, there may be used pure Vichy or Vals spring water in the form of gastritis, and in the low secretory and motor conditions, ssia amara (50 grams in a liter of cold water, macerated for twelve rs, and filtered), or fluid extract of condurango, 10 cubic centimeters a liter of water. It is obvious that the organ must always be empty these treatments.

Spraying without the return of the introduced solution can be cted with the Einhorn spray. The advantages of the spray are t it is quickly performed, that, together with the spray, air in fficient quantities to balloon the organ (so that the solution can e in contact with the mucosa) is introduced at the same time, and t with the use of nitrate of silver solutions the drug in aqueous

solution can be delivered directly into the stomach. When the instillation of a small quantity of a strong silver nitrate solution is desirable it is best done by the spray for the reasons that its conversion into silver chloride solution, from contact with the chloride salts in the stomach, does not take place, and also because it obviates the disagreeable features of the metallic taste, puckering sensations in the mouth, and staining of the lips. The tube is introduced to a distance of about 45 centimeters from the lips of the patient, and the spraying commenced. As the tube is being pushed down, half a dozen or more pressures upon the bulb should be exerted until the tube has been introduced about 20 centimeters farther. The use of this method of treatment is of value in the superficial catarrhal ulcers of chronic gastritis, and as a stimulant to greater mucus secretion in cases of hypersecretion. The use of silver nitrate is of no service as a stimulant to higher gastric juice secretion, or as an astringent to control excessive secretion. A 2- to 4- per cent. solution of silver nitrate may be used, care being taken not to deliver more than 0.2 gram of the silver salt at one time. At the time of spraying, the stomach must not only be empty, but should first be cleansed by lavage to remove the mucus, adherent food particles, free gastric juice, and bacteria. This requires the passage of two tubes, one for the lavage and the other for the spray, and consequently one is usually inclined to use a 2:1000 silver solution in the regular lavage way following the washing solution in preference to the employment of the spray. In my own practice, I have limited the employment of the Einhorn spray with silver solution to a short period in the late treatment of acute gastric ulcer when I believe it to be inadvisable to employ lavage and I wish to stimulate the process of healing. But as soon as the patient is up and about, I much prefer the therapeutic use of the X-ray for that purpose, because the results are quicker and more definite in each instance. In several cases of chronic ulcer I have used the silver nitrate spray with no appreciable results, operation being necessary in each instance.

Other instillations and methods have been used in gastro-therapeutics. Among these may be mentioned particularly the use of one of the bismuth salts introduced through the tube after the organ has been cleansed. For this purpose 10 to 20 grams of bismuth subnitrate in 200 cubic centimeters of water can be used, after which the patient lies for a few moments in different positions so as to coat the stomach mucosa. I have found this form of treatment of service in cases of persistent excessive secretion and particularly in late acute gastric ulcer, and in the irritative motor phenomena of peristaltic unrest and spasm of the pylorus. In excessive secretions when slight atony also exists and but little or no mucus is present (gastrosuccorrhea of long standing), I have

obtained some good results from the use of an alkaline lavage before breakfast and the instillation of 10 to 20 grams of bismuth subcarbonate in 100 cubic centimeters of a good quality olive oil. When the pylorus is patent and no gastric dilatation exists the taking of a glass or two of the alkaline or the alkaline sodium sulphate waters (which washes the stomach contents into the intestines) and the drinking of the above-mentioned instillations answer for the average case of excess secretion or the home treatment of a patient after a course of lavage treatment.

Einhorn<sup>2</sup> has introduced a powder-blowing apparatus for the insufflation of insoluble substances, the value of which has yet to be proven in clinical work. It seems to me that these substances, such as the bismuth salts, orthoform, protargol, powdered suprarenal gland, etc., can be given in just as effective a way and much more pleasantly by the drinking of these substances suspended in a menstruum, or in soft-elastic capsules.

#### KUSSMAUL PUMP. GYROMELE.

It is to the everlasting credit of Kussmaul that he conceived the idea and had the courage to use the first instrument for direct gastric work. His form of apparatus was a pump which, according to Bowditch's reports (1852), was used by the American physician Wyman for the purpose of draining empyemata. To this, Kussmaul added a long, stiff aspirating tube, and evacuated the stomach contents of a young girl who had long been a sufferer from gastric stagnation, which condition followed a cicatricial pyloric stenosis from gastric ulcer. Although this memorable event occurred on July 22, 1867, Kussmaul's report of the case is so full of classical medical observation and results from special therapy that it is worth repeating his conclusions as he gave them. The patient was a country girl, from Heimbach, aged 25, named Marie Weiner. She had been suffering from almost daily gastric pain and vomiting for fourteen years, and required the constant administration of morphine to relieve her and assure sleep.

"Quite frequently, when I observed the patient in the miserable prodromal stage of vomiting, the thought had occurred to me that I might ameliorate her sufferings by the employment of the stomach-pump, as the removal of large masses of decomposed gastric contents should cause the agonizing burning and retching at once to cease. The introduction of the esophageal sound was naturally not difficult, for where a gastric dilatation has existed for so long a time the esophagus also is usually dilated. The artificial emptying of the stomach by the pump could be no more painful or distressing than her condition before and during vomiting. At all events, it would be more rapid and complete than the natural emptying of the stomach by the act of vomiting, with its prolonged prodromal stage of nausea, pain and retching. Repeatedly, even after vomiting, palpation and percussion revealed

that the stomach still contained considerable masses. This condition reminded me of the so-called ischuria paradoxa, in which large amounts of urine flow daily from the dilated urinary bladder without its actually becoming empty and without contracting completely, and, if its elastic and contractile powers have not been entirely exhausted, perhaps even give to it the tone to contract to its smallest extent, just as the catheter occasionally brings about recovery in ischuria paradoxa.

"In our patient the gastric dilatation was due to constriction of the pylorus. At the autopsy of cases of extreme gastric dilatation I had repeatedly observed that the stenosis which caused them would still permit the passage of a small finger from the stomach into the duodenum, although toward the end of life there had

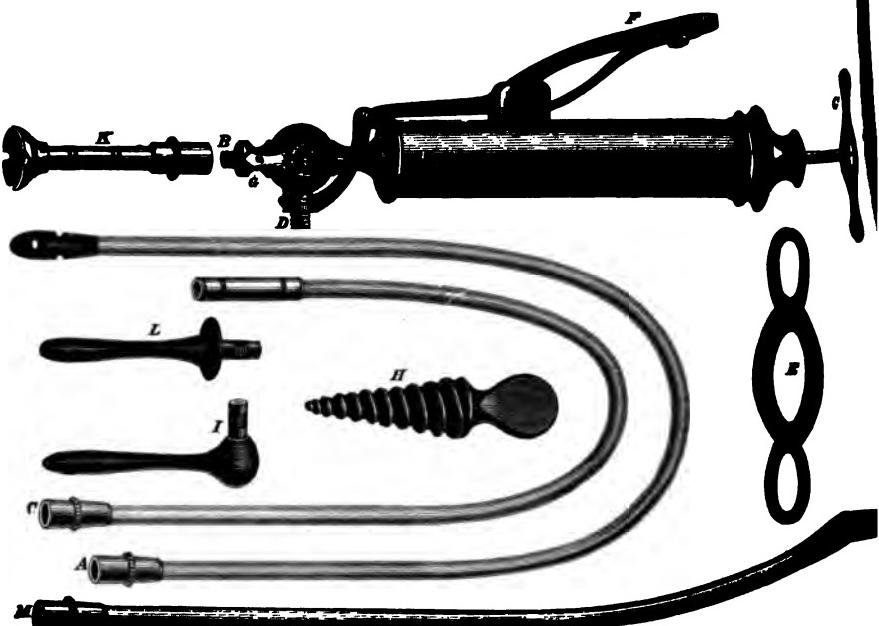


Fig. 97.—Kussmaul pump for rapid evacuation of stomach contents.

appeared to be complete closure of the pylorus. In such cases I had occasionally noted at the bedside through the abdominal covers active movement in the stomach. A paresis of the gastric musculature might be present, but certainly not complete paralysis. It appeared to me as though the excessive distention, the filling and overloading of the stomach itself, produced a mechanical action which increased the constriction of the pylorus to complete closure, and this condition I hoped to remove by emptying the stomach and decreasing its size.

"Finally it appeared that the employment of the stomach-pump would permit a more active topical treatment of the diseased gastric mucous membrane than was formerly possible. In the case of our patient this organ had for years been continuously irritated by extremely acid contents. The retention, stagnation, and decomposition of masses of food in the stomach because of pyloric stenosis is certainly often the only cause of the catarrh of the mucous membrane; as, for example, in cases in which originally there was but an ulcer or a cicatrix of the pylorus the

omach being otherwise intact; in all other cases it probably maintains and increases catarrh already present. This is probably why we note so constantly, in con-  
iction of the pylorus, that the mucous membrane about the pylorus, where the  
stic contents especially accumulate, shows most intense disease. The stomach-  
mp, I hoped, would not only make it possible completely to evacuate these acid,  
itating masses, but would also permit the washing and cleansing of the diseased  
cous membrane which had been irritated by acid and alkaline fluids, as, for  
tance, with Vichy water or with an artificial soda solution.

"The introduction of the stomach-tube, the pumping out, and the washing with  
chy water were unexpectedly easy. We withdrew three liters of acid, dirty gray,

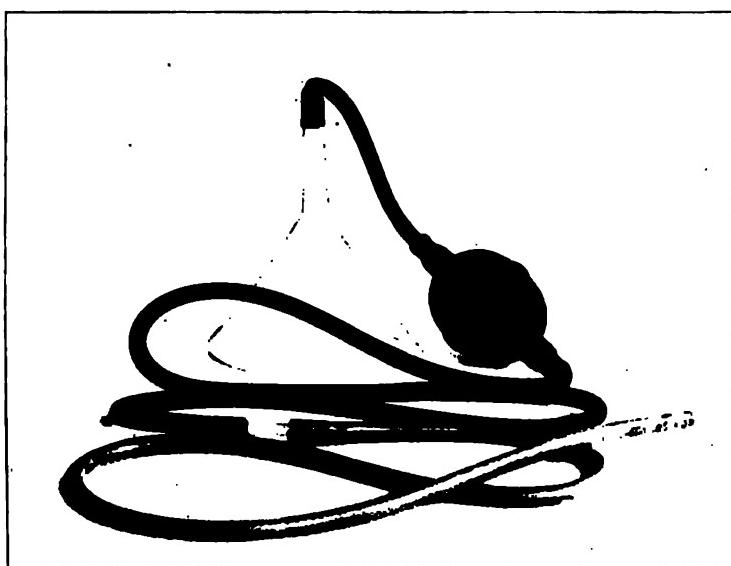


Fig. 98.—Author's continuous drainage stomach-tube apparatus.

mina-containing fluid, with particles of food of all kinds undergoing softening decomposition.

"Even the immediate result of the first emptying and washing of the stomach  
h Vichy water was a surprisingly beneficial one. The patient, who was previously  
ays exceedingly disagreeable, and of such a whining disposition that she well  
te out her name, 'Weiner' (crier), appeared a few hours later as if completely  
nsformed. For the first time she was agreeable and appeared comfortable in her  
i, and she declared that for years she had not been in such good spirits. She at  
te digested and slept much better, and for two days was entirely free from  
ressing sensations in the stomach. After repeated employment of the pump, at  
end of fourteen days the patient had a more healthy appearance and had become  
other being. She who had always been disagreeable, had lain in bed or reclined  
an arm-chair, was up the whole day, was very friendly, and attempted to make  
self useful about the room, and soon in other parts of the house. In the first  
ee months of her stay in the hospital, and before the employment of the pump,

she had gained at most about  $5\frac{1}{2}$  pounds in weight; two months afterwards she had gained at least  $16\frac{1}{2}$  pounds, and in not quite six months, 24 to 25 pounds. For two years recovery has been complete, although the patient is by no means in easy circumstances."

Following this, Jürgensen improved upon the process of stomach evacuation by the substitution of a soft tube which was introduced by means of a whalebone staff. To obviate the danger of the use of a stiff tube, Ewald and Nothnagel, independently of each other, learned that a soft tube could be introduced without the help of a staff. The stomach-tube of to-day, which was patterned after the Nelaton catheter, was first employed by Leube, since which time it has come into general use.

For the purpose of gastric work the Kussmaul pump and the stiff forms of stomach-tubes have only an historical interest. Even in poison cases in which a rapid and complete evacuation of the stomach is desirable, the fact has become generally known that the simple tube (stiff enough to hold straight when held vertically about 20 centimeters from the end) and the funnel answer for all occasions, and are always safe to employ.

For the purpose of removing excessive amounts of mucus, Turck has devised an instrument he called a gyromele. It consists of a stomach-tube with an end sponge which is rotated by means of an outside disk device. I have never used the apparatus, feeling that results from its employment would be questionable, and fearing that the sponge with its metal stem might become detached in its use and be left in the stomach, or that the sight or manipulation of the instrument might alarm apprehensive patients. Mucus which is so firmly adherent to the mucosa that it requires powerful measures to remove it had better be left there. The gastric mucosa is very soft, pulpy, and delicate, and will stand but little pressure or rubbing without injury. Therefore, I feel that the mucus that would not be removed by the use of lavage with the alkaline solutions, particularly when the fluid is flowing from an elevation, had better remain in the organ. For after all, mucus in a sense is nature's protection, and it is only the free form incorporated with the food or encountered in the treatment of the conditions that cause excessive mucus formation that concerns us therapeutically.

#### REFERENCES.

<sup>1</sup> BASSLER: "Sieving Pail for Lavage Water." Journal of American Medical Association, February 27, 1909.

<sup>2</sup> EINHORN: "Diseases of the Stomach." p. 172.

## CHAPTER XIV.

### Physical Methods of Treatment in Gastric Disorders.

*(Continued.)*

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#### BALNEOTHERAPY.

At the beginning of the consideration of this subject I wish to record my opinion that there is no special mineral water in existence, which, by virtue of its chemical constituents, possesses the power of curing any digestive, general, or katabolic condition or disease. Proof of this may easily be gained by the home use of the different waters for the cure of conditions for which their employment has been lauded by the various spas from which they came. In the many cases of digestive disorders I have treated in the past years, the value of the use of the many highly recommended mineral waters constantly came up for consideration and were employed many times in the treatments. Beginning years ago with an ambition to apply them as far as possible, and doing so according to the apparent proper selection of a water for the case, I have finally come to the belief that the chase after the illusive and mysterious molecule of therapeutic worth in them is much on the wild-goose order, and that such good as comes from their use is due simply to their neutralizing effects on high secretions and the dissolving of adherent mucus in gastritis by the alkaline types, the stimulating effects on low gastric secretion by the chlorine (muriated) and carbonic acid (acidulous) class, the purgative effects of the "bitter" waters in constipation, the simple tonic effects of the iron or chalybeate and the arsenical ones, and lastly, to the medicinal virtue that there is in the use of plain water itself as a necessary solvent, cleanser, and constituent of the body.

It is hardly fair to the general medical profession nor is it consistent with scientific medicine for spa authorities to ascribe curative results to the action of the waters of the springs in their possession by saying that the drinking of these fluids has and can cure the various forms of digestive disorders, without their laying more stress than is done upon the fact that the remedial or beneficial effects of a sojourn at the spa is most largely dependent upon the associated conditions, such as alterations in diet, freedom from business and domestic

worries, climate and out-door life, exercise, social surroundings, etc. In so far as the patient is concerned, there is no doubt that these latter conditions can be more conveniently, regularly and successfully carried out at the spas, but in reports to physicians the mineral waters themselves must not be given the sole credit for all of the good results that are achieved.

While at home, with many persons, who are surrounded by depressing influences and unhygienic conditions, it is next to impossible to guide the routine of life into a desired path and to have it continue thus, and for these persons, when their means and time permit of it, the physician often expedites results or brings about a greater benefit by recommending a course of treatment at one of the spas. Quite logically on these occasions, it should serve to better purpose if, in the selection of the place, one takes into consideration the main abnormal conditions of the case, and recommends a spa the waters of which in chemical make-up seem to meet one or more of the indications.

The better effects that are produced in the foreign spas compared to those of our own home country are derived, in my opinion, from the facts that the necessary trip across the ocean is a most healthy and quiet recreation where the patient is free from business and home surroundings, and always in the midst of strange, interesting, and companionable people; then comes the life at the spa, far removed from the home worries and influences; and lastly, the ocean trip back again, the entire vacation requiring at least five weeks' time. In our vast country, the few spas of value in which a general routine of treatment is religiously carried out are usually so far removed that it requires a long, stuffy, and fatiguing railroad journey to get to them and back again, and the mail, telephone, telegraph lines, and fast express trains usually keep up more or less communication with the patient. Added to these are the facts that the surroundings, people, quiet, and climate are not often so desirable as they are in the spas abroad—the waters themselves and the baths being as good.

Among the notable foreign spas in which the various types of waters are obtainable, and some of which can be procured here, are:—

#### **ALKALINE WATERS.**

##### **Simple Alkaline With Free CO<sub>2</sub>.**

Vichy, France.	Bilin, Bohemia.
Vals, France.	Passugg, Switzerland.
Fachingen, Germany.	San Marco, Italy.
	Borjom, Russia.

**Alkaline and Common Salt Waters.**

Royat (warm), France.  
 Ems Rock Spring, Victoria, Germany.  
 Apollinaris, Prussia.  
 Rhens, Germany.

**Alkaline and Sodium Sulphate Waters.**

Marienbad, Bohemia.  
 Carlsbad (warm springs), Germany.  
 Tarasp, Switzerland.

Among these, Vichy Celestins, Fachingen, Ems, Apollinaris, and Carlsbad  
 Waters are obtainable for home use.

**CHLORINE WATERS.**

(Containing mostly common salt.)

Ems Rock Spring, Victoria, Germany.  
 Wiesbaden, Kochbrunnen, Germany.  
 Homburg, Germany.  
 Kissingen, Rakoczy, Germany.  
 Selters (also alkaline), Germany.  
 Nauheim (warm, gaseous), Germany.  
 Droitwich (very strong in salt), England.  
 Nantwich, England.  
 Woodhall Spa (also bromo-iodide), England.  
 Bourbonne les Bains, France.  
 Châtelguyon (warm, gaseous), France.  
 Salies de Béarn, France.  
 Bex, Switzerland.  
 Wildegg (also bromo-iodide), Switzerland.  
 Salsó Maggiore, Italy.

Among these Weisbaden Kochbrunnen, Selters, Homburg and Kissingen, are  
 obtainable for home use.

**BITTER (or aperient) WATERS.**

(Containing mostly Epsom salts.)

Cheltenham (chlorides also), England.  
 Leamington (chlorides also), England.  
 Brides (chlorides also), France.  
 Apenta, Budapest.  
 Hunyadi Janos, Budapest.  
 Friedrichshall, Germany.  
 Pullna (chlorides also), Bohemia.  
 Carabana, Spain.  
 Rubinat, Spain.  
 Villacabras, Spain.

Most of these waters are only for export, and do not represent drinking

**TONIC WATERS.**

La Bourboule (arsenical), France.  
 Mont Dore (arsenical), France.  
 Bussang (alkaline arsenical), France.  
 Orezza (ferruginous), Corsica.  
 Guberquelle (arsenical, ferruginous), Bosnia.

Levico Mild and Strong (arsenical, ferruginous), Austrian Tyrol.

Mitterbad (ferruginous), Austrian Tyrol.

Pyrmont Steelwater (chlorine, ferruginous), Germany.

Schwalbacher, Stahlbrunnen (ferruginous), Germany.

Many of these waters are possible to procure in this country.

Among the American waters that may be used in practice are firstly the imitations of some of the foreign waters that are supplied in siphon and bottle containers by the mineral water concerns. Among those that are readily procurable, and which in my belief when properly made are just as serviceable to use as the more expensive imported waters, are the following:—

NAME	CHARACTER	APPROXIMATE PARTS TO 100.000 OF THE IMPORTANT SALTS
Artificial Vichy	Alkaline	Sodium carbonate, 380.1; sodium chloride, 57.8; calcium carbonate, 25; potassium sulphate, 20.5; sodium sulphate, 11.7; magnesium carbonate, 3.5; and total mineral ingredients of 506.338.
Bilin	Less alkaline than Vichy	Sodium carbonate, 300.8; sodium sulphate, 82.6; calcium carbonate, 40.2; sodium chloride, 38.2; magnesium carbonate, 14.2; potassium sulphate, 12.8; silica, 3.1; and total mineral ingredients of 495.598.
Selters	Chlorinated and alkaline	Sodium chloride, 225.1; sodium carbonate, 80.1; magnesium carbonate, 26; calcium carbonate, 24.3; potassium sulphate, 5.1; potassium chloride, 4.6; and total mineral constituents 369.780.
Ems	Alkaline and chlorinated	Sodium carbonate, 140.5; sodium chloride, 97.7; calcium carbonate, 15; magnesium carbonate, 13.5; silica, 4.9; potassium sulphate, 3.6; and total mineral constituents 279.777.
Carlsbad (Sprudel)	Sulphated and alkaline	Sodium sulphate, 240.5; sodium carbonate, 131.5; sodium chloride, 102.2; calcium carbonate, 32.2; potassium sulphate, 18.6; silica, 7.1; lithium chloride, 1.4; and total mineral constituents, 551.6738. This water is also supplied by some firms in double and quadruple strengths.
Marienbad	Sulphated and alkaline	Sodium sulphate, 472.2; sodium chloride, 145.3; sodium carbonate, 114; calcium carbonate, 59.9; magnesium carbonate, 46; silica, 8.8; potassium sulphate, 5.8; ferrous carbonate, 4.5; and total mineral constituents 859.154.

NAME	CHARACTER	APPROXIMATE PARTS TO 100,000 OF THE IMPORTANT SALTS
Kissengen (Rakoczy)	Chlorinated	Sodium chloride 582.2; calcium carbonate 106; magnesium sulphate, 58.7; calcium sulphate, 38.9; potassium chloride, 28.6; ferrous carbonate, 3.1; lithium chloride, 2; and total mineral constituents 855.-5908.
Homburg	Chlorinated	Sodium chloride, 986; calcium carbonate, 151.1; magnesium chloride, 72.8; calcium chloride, 68.7; potassium chloride, 34.6; and total mineral constituents 1329.731.
Saratoga Artificial	Chlorinated and alkaline	Sodium chloride, 732.9; calcium carbonate, 144.4; magnesium carbonate, 100.3; sodium carbonate, 30.8; potassium chloride, 21.5; lithium carbonate, 4.7; sodium bromide, 3.3; and total mineral constituents 1047.1746.
Kissengen Bitter Water	Sulphated	Sodium chloride, 795.5; sodium sulphate, 605.4; magnesium sulphate, 514.3; magnesium chloride, 393.3; calcium sulphate, 134.6; magnesium carbonate, 51.9; potassium sulphate, 19.8; magnesium bromide, 11.3; and total mineral constituents 2529.5699.
Pullna	Sulphated	Sodium sulphate, 1611.9; magnesium sulphate, 1212; magnesium chloride, 246.5; magnesium carbonate, 91.8; potassium sulphate, 62.5; calcium sulphate, 33.8; and total mineral constituents 3272.2068.
Schwalbach	Ferruginous	Calcium carbonate, 15.3; magnesium carbonate, 13.9; ferrous carbonate, 6; manganese carbonate, 1.3; and total mineral constituents 43.1974.
Pyrmont	Ferruginous and manganous	Sodium chloride, 115.9; calcium carbonate, 100.1; magnesium sulphate, 41; sodium sulphate, 28.9; manganese carbonate, 9.5; ferrous carbonate, 4.3; and total mineral constituents 315.765.
Iron Water (Carl H. Schultz's)	Ferruginous	Ferrous carbonate, 12.763. Six ounces containing 0.35 grains of ferrous carbonate.
Pyrophosphate of Iron Water (Carl H. Schultz's)	Ferruginous	Pyrophosphate of iron, 39.0635. six ounces containing 1.07 grains of pyrophosphate of iron.

There are also certain spas and natural domestic waters that may be used for the purpose. The most notable of such are:—

#### **ALKALINE WATERS.**

Bear Lithia, Elkton, Va.  
 Bedford, Bedford, Pa.  
 Bethesda (calcareous, alkaline), Waukesha, Wis.  
 Clysmic, Waukesha, Wis.  
 Londonderry Lithia, New Hampshire.  
 Saratoga Hathorn (also chlorinated), N. Y.

#### **CHLORINE WATERS.**

Deep Rock, N. Y.  
 Franklin Lithia, N. Y.  
 Saratoga Congress, Selter, and Kissengen, (the latter slightly laxative), N. Y.

#### **BITTER WATERS.**

Mt. Clemens Bitter Water (chlorinated), Michigan.  
 Pluto (chlorinated and sulphated), French Lick, Ind.  
 Red Raven, Pa.  
 Saratoga Kissengen and Lincoln, N. Y.  
 West Baden (chlorinated and sulphated), French Lick, Ind.  
 Abilene, Abilene, Kan.

#### **TONIC WATERS.**

Abita (ferruginous), Louisiana.  
 Rockbridge (ferruginous), Virginia.  
 Bedford Alum Spring (ferruginous), Bedford, Pa.  
 Church Hill Alum Spring (ferruginous), Virginia.  
 Rock Enon Springs (ferruginous), Virginia.  
 Vichy Springs (alkaline, ferruginous), California.  
 Estill Springs, Kentucky.

Some of the additional practical observations that have come to me in my medical work pertaining to the subject of spas, waters, climates, etc. may be mentioned. The alkaline waters and spas are of the greatest service in hyperesthetic as well as hypersthenic conditions of the stomach. They are also of value in the general neurotic and gouty cases—in which latter it may be said that the stronger alkaline waters are often not as serviceable as the mild. The presence of a small amount of arsenic in chlorinated waters (Ems) is sometimes of added service in hypochlorhydria. A large class of dyspeptics, who are rendered so by gross feeding and alcohol, those who have congested livers, constipation, lithiasis, gout, or defective elimination with super acidity, do best at the spas or with waters of the alkaline aperient sodium sulphate type. In neurotic and neurasthenic conditions of extreme forms it is best to begin the administration of the water warmed. Carlsbad, Vichy and Neuenahr are the best spas and waters for those with disease of the liver and gall-ducts.

Nauheim, because of the gaseous thermal brine baths, is the preference for cases of cardiac neuroses, valvular and heart muscle disease, and also the high tension arterial conditions, either functional or organic in nature. For neurasthenics it is better to advise going to a spa where the waters are less of a feature of cure than the quiet, good foods and climatic conditions—among these are the less frequented baths, particularly those in the mountains. The three spas most resorted to by diabetics are Carlsbad, Vichy, and Neuenahr in which the warm alkaline waters are obtainable. English-speaking patients who have anemia and chlorosis seem best suited, for social and other reasons, at Schwalbach, Spa, Pyrmont, and St. Moritz; and German patients seem more contented at Schwalbach, Königswart (near Marienbad), Bocklet (near Kissengen), and Driburg in Westphalia.

## CHAPTER XV.

### Indications for Surgery.

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IT is one of the pleasant auguries in this field of medicine that modern progress has brought the medical and surgical sides of the work so closely together. On the medical side we are reaching the days of complete and definite knowledge in the diagnosis and treatment of gastro-enterological conditions. Centered clinical experience assisted by ability in special technique and laboratory procedures is carrying us toward a state of perfection in being able to discern many of the formerly unfathomed conditions which were the parents of the exploratory incision, a just performance in some of the undiagnosable cases of a grave nature, but a wrong practice if a diagnosis can be reached without resorting to it.

On the other hand, because of the high rates of mortality in surgical procedures of the gastro-enteron, the desirability of a practical knowledge of what is wisest to do to obviate or remove the error when the abdomen is opened and the condition is observed, the value of a skilled hand for the various operative procedures pertaining to the surgery of the digestive tract, and the importance of perfect work quickly done, necessitating as it does a good understanding of the anatomy and physiology of the parts, the time has arrived for the existence of surgeons who have aptitude for this class of work, and whose skill, born of ample experience, is beyond that of the average general surgeon.

I would suggest, to help bring this important matter nearer to perfection, that, however reached, a satisfactory diagnosis or desirable knowledge be first attained (if at all possible) by the exhaustion of all clinical means before resorting to surgery for this purpose. It must nevertheless be remembered by the internist that to be too conservative and drift aimlessly along until conditions have passed beyond the hope of surgical cure before the case is handed over to the surgeon is quite as bad practice as engaging in hazardous operative procedures without previously knowing just why or estimating the possible loss or gain. Each case that is seen is a law unto itself, and some cases from their onset rightfully belong to the medico-surgical class, and not to the medical or surgical class alone. This fact must be observed by both physician and surgeon, the surgeon often standing somewhat in the background until it is apparent:

that the operative course is the wisest to pursue. The knowledge that the surgeon gains by thus waiting and observing is most important to him in the work that is found for him to do; thus it would doubtless be that many of the cases that are operated upon unwisely or too late for benefit to the patient would be saved from useless surgical interference, and the surgeon's statistics would perforce be that much better.

In this matter, which I look upon as an important question in medicine to-day, full service to patients is not given for several reasons. General practitioners are depending upon medications without a diagnosis too long, usually trying one mixture after another in the blind hope that luck, time, and a simple service will win out in the end. If it should not, many of them pass the case into surgical hands. With these and those that come earlier, the average surgeon I have met depends almost entirely upon exploratory incision for a diagnosis or a short and superficial examination for the purpose of developing a reason for surgical interference. Perhaps the case, through the attendant or directly, comes to the "stomach specialist," and he is of the type who makes a superficial examination with perhaps a test-meal extraction and a diagnosis on these (which in many surgical cases means further temporizing), or the case goes to a general hospital wherein the fullest kind of diagnosis work in gastro-intestinal affections is not done or men who are skilled in this line are not in attendance. Fortunately the best of our surgeons are now recognizing (because of mistakes in diagnoses and an operative mortality) that the exploratory incision is not sufficient, and that those who are capable diagnosticians in this line are invaluable to them for results. In the rush of the moment they had not observed that the operative results of the most brilliant surgeons in abdominal work were based upon thorough medical work on each case before the case was operated upon, and when operated upon there was a good and substantial reason for doing so. The answer to the question is merely one of examination by one skilled in diagnostic work of this kind as well as in all other conditions of internal medicine. Mistakes in diagnosis are often due to a lack of examination and proper interpretation of the findings. W. J. Mayo has truthfully stated: "The first step in the diagnosis of supposed disease of the stomach should be a general physical examination, in order to eliminate causes of gastric distress which originate in diseases outside of the digestive tract. We should then eliminate the non-surgical diseases, *i.e.*, atonic dilatation, prolapse and gastric neurosis, etc." The diagnostician should always follow the cases through the operation and have a good knowledge of surgery in addition, for such a man, with his knowledge of the case on his finger-tips, often is a most valuable addition in the operating room in more ways than one.

In the writing of this chapter, the author can only be general, giving rules which have served him in the past in the cases he has seen. It is hoped that these as they may present themselves in any case will be helpful in deciding when surgical procedure should be resorted to.

#### MALIGNANT DISEASE.

Cancer is a surgical condition. In its beginning, it is possible of absolute cure when the growth is freely and completely excised. When, however, the growth has gained considerable size and has spread into the stomach walls, the results from removal in the way of recurrence are only poor; while in those cases where the tumor is easily palpable from without, and the mass involves structures surrounding the stomach with the destruction of the digestive and dynamic functions of the organ, the results are generally fatal to the patient and operation should not be performed. Added to these, are those cases of rather slow disease which are not operable in the way of extirpation, but in which a gastro-enterostomy would bring comfort and prolong life; and those numerous cases of persistent gastric disorder which are tinctured by the suspicion of the presence of malignant disease in which exploratory incision is a valuable and essential aid to diagnosis. The first factor in this connection is early diagnosis, and although gastric cancer is a digestive disorder of a primary nature and is frequently encountered, diagnosis of the condition in its early stages is not always easy and often is impossible by medical means. The disease is met with so differently in its course, sometimes rapid, sometimes chronic, and always insidious in its beginning. The cases of very sudden onset are in the minority. Usually it develops at the end of a lengthy dyspeptic condition in which a history of an early gastric ulcer may be obtained. There are no definite subjective symptoms characteristic of its presence in early cases. There may be increasing anorexia, occasional nausea and vomiting, distress after meals, sense of oppression, distaste for meats, and so on, and again not one or any other local symptom may be present. Pain, marked vomiting, hemorrhage, dilatation, and tumor are all late local symptoms. It may be said that the diagnosis of early cancer can practically never be made by physical diagnostic means alone. Upon what then must we depend? In the order of their importance I would mention them briefly as: X-ray observations, history, frequent examinations of the stomach with the tube, and of the feces, general observation of the patient and the daily use of the scales, and a ready recourse to exploratory incision.

Assuming now that after close enough attention to a case suspicious findings have been obtained, what is the proper course to pursue? Wait until definite symptoms of the disease develop, which are usually those of well-advanced growth? No! An exploratory incision which need not be larger in extent than that through which the stomach can be properly explored by the finger. It must be recalled and always recollect that cancer begins as a small nidus of cells, one too small to give much or any symptom in any way, and that from this beginning it generally advances until death unless it has been discovered early enough for its complete removal. That is the course which makes possible ideal surgery in these cases, and by a close medical observance, and then a quick, courageous surgical hand, some of them may be saved. The internist must do more than simply determine plain cases for operation: he must also call upon the surgeon for elucidation when the condition is not clear to him and the case is of a suspicious nature. In these days of better surgery, as was mentioned before, exploratory incision when properly and carefully done is not attended with much danger to the patient, and the results possible to accrue from it are often brilliant enough to overshadow the instances in which after its performance it may have proved to be unnecessary. The foregoing remarks also pertain to sarcoma of the stomach.

#### ULCERS.

Acute ulcers, under ordinary conditions, are medical affections. When they do not heal properly or completely, perforate, bleed too freely, or develop sequels, such as marked cicatrical contractions, pyloric stenosis, perigastric adhesions to other organs, or degenerate into carcinoma, they are surgical affections, medical treatment being only palliative in by far the largest number of cases.

There is little question in my mind that a stricter attention to details in the diagnosis of acute gastric ulcers than is common to-day, a greater persistency and prolongation of the treatments by rest, proper dieting, medication, etc., will mean better curative results and fewer cases for ultimate surgery. There are met with, however, several types of cases of acute ulcers in which the necessity of surgical procedure comes up for consideration early in their course.

The first of these, in my experience, is the persistent vomiting of even trivial amounts of carefully selected and prepared foods. In such cases, the irritation constantly present in the stomach from the ulcer causes a watery, sometimes sanguineous, discharge which is vomited rather steadily, whatever is done in the way of treatment. These cases are seen in the young and middle aged, are usually very

acute in their onset, and are altogether pitiful. If, after several days or a week of observation, despite all treatments, the condition continues in severity, operation is to be considered. The next type is the one in which the intensity of a boring pain in the stomach does not abate with medical treatment (no opiates) after a reasonable length of time. Here, the picture is also a sorrowful one. After two weeks or more of treatment by internal and external measures, the use of rectal feedings to control the epigastric distress, and so on, the patient is in constant agonizing pain, horrified at the sight or even the thought of food, the face intensely anxious and drawn, and the knees raised; operation should be thought of here. Then, again, there is a type of case in which the hemorrhage persists (usually macroscopic) in a constant or intermittent flow. Day after day, in spite of all treatments, this continues until the patient is reduced to a state of severe anemia. Sometimes but little vomiting occurs and only the feces presents the evidence of bleeding from the stomach (even pain may not be marked), but still the loss of strength continues and the better physical picture of the first days in bed fade into those of extreme devitalization and ante-mortem apathy. Many of these could be saved, or at least relieved, by early surgical intervention, in which it may be said that the rate of mortality is only between 1 and 10 per cent. But how about the cases which are ushered in with severe hemorrhage? With them it can always be asked, Is this bleeding from a large vessel that can easily be found? No; for in my experience this excessive flow can also come from the most trivial and impossible to find spots, as well as most often from ruptured varicose veins in the stomach and open vessels in the ulcer base or sides. In this variety of cases few survive surgical operation, and the rate of mortality from medical treatment is better than that from surgical. Still, the hemorrhage in such a case may suddenly stop for a while, only to flow again as before. Here surgery may be of signal help.

Next comes the case of perforation of the ulcer into the general peritoneal cavity, found in about 1 in 12 of all true ulcer cases that come under observation. When diagnosed or suspected they should all be operated upon at once. In these cases the physician shoulders too grave a responsibility to delay. Success, of course, hinges upon an early diagnosis, and every hour of indecision and delay lessens the chances for recovery. Perforation is usually characterized by the sudden onset of an intense pain over a strictly localized spot, which on pressure, early in the case, is quite unbearable to the patient. The abdomen becomes rigid, the pulse rapid and small (or maybe as low as 30 to the minute) and the face anxious, angles of the mouth drawn down, and the color ashen. The feet are often found cold, and a cold sweat

bathes the body. This is the typical case with a large and free opening into the peritoneal cavity. Sometimes, however, these general symptoms of shock are absent, and we are not able to diagnose the condition early. Even the local pain may be more or less absent, and we are not warned of the condition until a more diffuse pain develops. This means localized peritonitis, and is generally followed (in from 1 to 12 hours) by rigidity of the entire abdomen. As this rigidity subsides, in its place there occurs a gradual increase in the size of the abdomen, due to paralytic distention of the intestines and the presence of gas escaping into the general peritoneal cavity. When the latter occurs, it balloons the abdomen quickly, causing an absence or diminution of the liver dullness. The breathing then becomes costal and rapid, because of the increased upward pressure on the diaphragm. The patient is restless and generally distressed, and tries to guard against every possible movement. The outcome of an operation now becomes a grave question, but it nevertheless should be performed, even in the presence of a diffuse peritonitis, for in a few hours more the patient is most likely to be in a moribund condition, and then his last chance of recovery and the moments in which we might have assisted him are gone. Figured in 12-hour intervals after a perforation, the mortality of operations according to Boyd is, in the first 12 hours, 28½ per cent.; in the second 12 hours over 63 per cent.; and in the third 12, over 87 per cent. Patients seen after the second day often have localized suppurations or plastic adhesions, and thus the operative results are somewhat better.

We are now brought to the consideration of the unhealed ulcer and post-ulcer irritative conditions of the stomach in cases in which an acute ulcer is supposed to have healed, and the truer forms of chronic ulcers. It must be apparent, not only in connection with the above but also in all of the sequels of gastric ulcers, that if more of them were diagnosed and treated properly in the first instance, fewer would be the baneful results from ulcers and fewer the necessities for operation. In an acute ulcer that has made favorable progress during the course of medical treatment one should be guarded in decreeing it as cured until several years have elapsed. How often in our clinical work are cases seen which, having a history of ulcer some time back, come again under observation with conditions in which the art of medicine can render but little permanent service to the patient. It is my opinion, as well as a practice I would strongly advise, that all of the apparently successfully handled acute ulcer cases be kept under surveillance and carefully examined from time to time so as to observe that conditions continue as they should.

Clinical ulcer usually means destruction of gastric tissue down to

the muscularis, and the tissue, which has died and is digested away, is gone to be replaced by common scar tissue. As compared with the healing of the gastric mucosa from injuries, ulcers of large size heal slowly and imperfectly at best. The small ones do much better, but how few of these do we diagnose? Many of them do not come under medical inspection, and if so, too often they are not diagnosed nor properly treated. Healed unknown ulcers of the stomach are not infrequently seen at autopsy, in my experience.

Ulcers heal by a regenerative proliferation of the connective and glandular tissues that border the ulcer. The cells of the mucosa near the margin of the defect are chiefly concerned in this. All the time that this delicate repair process is slowly taking place, the stomach is secreting more or less hydrochloric acid and enzymes, and digesting foods. The truth is, that, even under most favorable conditions, an ulcer takes weeks to heal, and often there are several to go through this process. Now, how easy it is to understand how this same ulcer, acting as it does as an irritant to the stomach, exciting a greater flow of gastric juice and increased motility, is thus unfavorably influenced in its repair process. Added to this is often seen what is common in most continued gastric disorders, an atonic condition of the musculature with the resulting retardation of the food in the stomach, and thus even more prolonged irritation to the ulcer itself. The progress of all acute gastric ulcers is more or less uncertain, both in their duration and prospect of healing. This must not be forgotten nor looked lightly upon by the internist. Statistics of medical cures should not be based upon the condition immediately following treatment. When figuring the absence of sequels, it takes three years at least to be sure of this.

After an acute case has been treated a sufficient length of time in bed and under strict observance to diet, constant pain in the stomach coming on immediately after eating and keeping up for weeks, pain which is made worse by the ingestion of coarse foods, such as heavy vegetables, is suspicious of an unhealed ulcer or an irritable scar. Only a feeling of distress after eating may be present in place of pain. While the latter is not sufficient in itself to demand operation, when observed constantly for a length of time its relativity to irritability from food and gastric juice is significant.

A history of more or less steady vomiting is even more important than pain. When pain and distress are also present with the vomiting, and these are at once relieved when the stomach is empty, it is significant of the repair not being complete. This vomitus cannot be depended upon to enlighten us by chemical examinations, even when a test-meal had been present in the stomach; but, it is an important matter when blood

is constantly present in this vomitus. The latter is not found as a common picture in unhealed ulcers, for many of them remain so and do not bleed at any time. I would advise as a routine in all post-ulcer cases that from time to time X-ray observations be made and the stools examined for occult blood. The taking of a mild cathartic after 1 or 2 days' fasting from meat, etc., and a test of the feces for blood are not such difficult matters. Capillary oozing with small amounts of blood passing off from the bowels may continue for months in those cases without our knowledge of its presence unless we look for it. The patient's statements cannot be depended upon in this, because this blood is usually not recognizable by the eye.

Now come those cases which never seem to get well on any form of stomach treatment or special dieting—"chronic dyspeptics." Their histories are so varied and complex that it is difficult to describe them. Sometimes these persons waste in flesh and strength; then, again, they are found quite well nourished. Their stomachs are always more or less irritable, and when they are fatigued from work they have gastric pain. Some with careful dieting run along and perhaps feel somewhat better, then on the merest dietary indiscretion they renew their vomiting and have return of pains. These persons, characteristically, are always guarding their epigastrium from pressure, the slightest amount of which causes distinct pain. The picture can be almost endlessly enlarged upon, but when, after an ulcer, a chronic dyspeptic history begins, or that which was present before becomes much worse, and this keeps up continuously, an unhealed ulcer, or an irritable scar should be thought of, and in both of these conditions the recourse to surgery gives good results. In the majority of cases of this kind, it has been my practice when the conditions seem fair enough to warrant the possibility of its success, to recommend first another course of strict ulcer treatment in bed, or a prolonged rest in one of the well-ordered sanatoriums, or possibly a sojourn at one of the foreign spas, such as Kissengen. These latter measures have brought quite a few of such cases to a satisfactory condition of health and digestion, which no doubt was accomplished indirectly by better local conditions for the repair of the stomach ulcer. I am not considering true sensory neurotic conditions in this connection.

The pathology, clinical course, and duration of gastric ulcers differ so markedly in cases, that to describe what may be designated as a chronic ulcer becomes almost impossible. Quite naturally, all of the post-acute gastric ulcer conditions, wherein there is a continuation of gastric distress, whether these are directly due to the ulcer being partially healed, or are more on the order of sequels following it,

are designated as chronic ulcers. But when an ulcer has once filled in with scar tissue, providing this is uniformly intact, it is truly no longer an ulcer in the proper acceptation of the word. What the author designates as chronic ulcers are rather the slower forms of ulcers seen in those past middle life. In the old, whose tissues are not capable of the repair process found in the young, an ulcer is found which has features peculiar to it alone. The ulcer is sometimes of the treasted or shallow running type, most irregular in its shape and often of considerable size. Another form, which is more common, is the one with a shaggy looking surface consisting of jagged ends of connective tissue hanging free in the stomach, while below this is a thickening and massing of connective tissue which extends down through the submucosa to the muscular layer. In the first, but little organization of new growth tissue has taken place, and the stomach walls are soft and flat, while in the latter a conglomerate mass under the ulcer may form quite a tumor in the stomach walls, rendering it stiff at that locality and sometimes for a distance beyond it.

Clinically, these cases present a chronic form of dyspepsia in which most of the classic symptoms of new ulcer or immediate post-ulcer conditions are lacking. Because of prolonged illness, many of these patients become quite cachectic looking and gradually become reduced to a state of debility. It must be evident in most of these cases, that little could be expected in the curative way from any form of medical treatments, although the therapeutic use of the X-rays sometimes offers signal benefit. Because of this, of their morbid nature, the age of the individual in which they are usually found when there is an ever-present tendency to carcinomatous degeneration, surgical intervention offers the best help for them. I consider the old-healed ulcer in which, from contraction of cicatricial fibers and strangulation of the blood-supply, necrotic areas are present in the scar also as one of the chronic ulcer types. I might also say in this connection that, excepting in the cancerous form mentioned, gastro-enterostomy is often curative, but that the excision operations would give the best results in the end in the majority of cases.

It is my belief that in some persons susceptible in that way, even when an ulcer has healed over, and certainly in many of those in whom the chronic form of ulcer exists, a carcinoma may at some time develop. After the healing of the acute gastric ulcers there is frequently found a large number of tubules in the center of the scar. These are usually very irregularly inclosed and are found running in all directions to the free surface. Many of these cavities are cystic in type and are not lined by the physiological cells found normally in

gastric tubules. Instead of these, is found a species of cylindrical epithelium which performs no secretory functions, but, as Hauser asserts, are merely adenoid neoplasms. These cells are inclosed in connective tissue which at the best, as time goes on, is but poorly nourished, and this, subjected as it is to the constant mechanical irritation of foods and gastric motility, together with the chemical irritation of HCl, may proliferate into malignant disease. The first thought in these cases of chronic ulcer should be operation; which type is the wisest to pursue depends much upon the history of the case itself, on the condition locally and generally, and again according to when the condition is first seen or diagnosed. It would here be well to remember that many of the carcinomatous ulcers are impossible to diagnose in their beginning, and sometimes even late in their course when they are encapsulated in structure and form, because they often are outside of the free surface of the stomach; thus it is, that a rather liberal dependence upon the surgeon is generally necessary to assist in making an early diagnosis for us.

Another word may be said regarding the desirable form of operation for chronic ulcers, and the subject of diagnosis between cancer and benign ulcer at operation. It is evident that whatever the appearance or feel of this ulcer may be, whether saddle-shaped or otherwise, soft or densely thickened with induration, or wherever it may be situated, in the pyloric region or in the lesser curvature, the best forms of operations are those in which the entire diseased tissue is removed (excision, pylorectomy or partial gastrectomy). Of course, where extensive adhesions to surrounding organs are found, such operation may not be possible, but it must be remembered that gastro-enterostomies are operations merely for better drainage and have only to do with improving the dynamic and chemical status of the stomach for the ulcer's healing, and not with the complete cure of the actual condition. Many patients of the cancer age who have had benign ulcers at the time of gastro-enterostomy subsequently improve, only in the course of time to develop malignant disease. And it may further be said that gastro-enterostomies, even when the results from them in the purpose for which they are performed were successful, are sometimes a failure in the benign ulcers when these have been of long standing and are organized with new tissue. In ulcers of the duodenum gastrojejunostomy is a most satisfactory operation.

An indurated gastric ulcer may be in the early stages of carcinoma development and when seen and examined be impossible of naked eye diagnosis. The carcinoma cells may be discreetly scattered in the ulcer base or edge, and be very few in number. I have seen cases of perfectly soft ulcer of small size in the lesser curvature, which

looked entirely innocent from a malignant standpoint on the mucosa side, but which presented a wart-sized, carcinoma nodule on the peritoneal surface of the stomach some distance from it. Finney reported two cases in which at operation with the abdomen open he was unable to decide whether he was dealing with a carcinoma or an ulcer at the pylorus; and no doubt there have been many more just such cases. Examination of frozen sections for diagnosis in the operating room means the dangerous cutting into tissue that may be malignant and the spreading of the carcinoma cells. Then again, if the report be benign, the results of these quick examinations are not to be depended upon. At the expense of repetition, chronic ulcers and those which are not properly healed, however innocent looking they may be at operation, should be removed if at all possible, gastro-enterostomy being only the second choice.

Pyloric stenosis following ulcer may come about in one of four ways—cicatricial contraction, malformation resulting from a rather general thickening of the connective tissue in the stomach walls, the drawing away or binding down of perigastric adhesions, and malignant disease. To these may be added the partial kinking of the first portion of the duodenum due to the downward pulling of a heavy, dilated stomach.

The most difficult point medically in the treatment of gastrectasia following gastric ulcer is the matter of just what the dilatation is due to—whether it is a plain atony or one secondary to obstruction to the easy flow of chyme through the pylorus. It is important to keep in mind that about 10 per cent. of pyloric stenoses follows gastric ulcer, and that when this occurs medical treatment can offer little in the way of a permanent cure. When, however, this stenosis is benign in nature and slight in extent, much in the medical way can be done in the matter of satisfactory relief; when it is moderate, by the strictest care, these cases can be kept comfortable; but when there is distinct stagnation and fermentation of foods, the case is decidedly surgical. One must not be led astray and too hastily diagnose stenosis in the cases of acute ulcer which present much relaxation of the stomach during their course, or the simple atonies that may follow.

Cicatricial contraction of an ulcer situated at the lesser curvature or some distance from the pylorus if it is of considerable extent is liable to cause marked constriction. These constrictions are also found nearer the pylorus and in the duodenum itself, but very rarely near the cardia. The typical hour-glass stomach of even proportions is rare and easy to diagnose, but the irregular forms, where the constriction is near, at, or beyond the pylorus, require more detail, time, and patience.

in their clinical discernment. Those ulcers which are followed by much annular thickening in the stomach walls and the pyloric stenosis of late hypertrophic gastritis are distinct surgical conditions.

For the observance of cicatricial changes and in the selection of cases for surgery, as well as for diagnosing perigastric bands, the X-ray pictures with bismuth in the stomach are most helpful. The seven or more hour extraction of the Leube test-meal are not so helpful. The washing out of the morning stomach after a heavy mixed meal the evening before, and the finding of food remnants are of course very valuable to these ends, but definite results in this are observed only in very marked cases of stenosis. The external observances of the cramp-like peristaltic waves forcing food through the obstructed pylorus are likewise also valuable. Those cases with distinct collective vomiting, intense thirst, diminution of urine, tetany, and marked fermentation, all have more or less complete stenosis, and for these the excision, pyloric plastic operations, or gastro-enterostomies can be resorted to.

The last class of cases in which operations are indicated, are those with the presence of benign growths, such as large-sized obstructing polyps or papillomata. The congenital stenoses (of which I have seen three cases live to adult life) are also included, as well as those of foreign substances in the stomach, as hair balls, or the swallowing of articles, as may be observed in those of vicious habits, such as in the hysterical or the insane.

The internist must be fair to his patient, and deliver to the surgeon many of the cases of generally termed "chronic dyspeptics" when these do not improve or become worse under his care, and in which surgery offers possibilities of a better therapy than is at his command. All cases in which this is advised should first be carefully examined and, if possible, diagnosed in advance, and reports given to the surgeon as to what the findings may be, as well as any suggestions that may be logical. When a severe case continues to present a mystery, a kindly disposed and understanding surgeon, cognizant and discreet, can, by the performance of an exploratory incision, be of inestimable help. Neither side can be firm of stand, for gastric surgery before a few years ago had no more to its credit than had the internist in diagnosis and treatment. To-day, mistakes on both sides are gradually disappearing, and knowledge and understanding in this field of medicine are becoming more perfect.

## CHAPTER XVI.

### Gastric and Esophageal Surgery.

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#### GENERAL CONSIDERATIONS.

SINCE the memorable advent in medicine of antiseptic and then aseptic surgery, operations upon the organs in the abdominal cavity, as well as those in the thoracic and cranial cavities, have been largely robbed of their terrors. To-day, throughout the world generally, surgeons are awake to the therapeutic possibilities existing in surgery of the gastro-enteron and the accessory organs in the abdomen concerned in digestion (gall-bladder and ducts, liver, and pancreas), and this field of work is not only receiving an intense degree of interest, but in many substantial ways has passed the experimental stage and developed into one of most valuable service, attaining results impossible from the employment of what may be termed medical measures alone.

The foregoing chapter pertains more particularly to those cases in which diagnoses can be made or strongly suggested. But in clinical work many if not the majority of cases seen come with a length of masked history or a complex multiplicity of symptoms and upon examination no definite clinical suggestions sanctioning surgery may be noted. For these reasons the author feels it important to consider this subject from the opposite standpoint, namely, that in which the indications of surgery develop from certain symptomatic findings rather than from definite diagnoses.

The intimate anatomic and functional relationship of the organs in the upper abdomen, the stomach, duodenum, pancreas and biliary apparatus, often makes definite diagnosis difficult because of the similarity of symptoms occurring in different diseases of these structures. In distinguishing these from one another, close attention to details in the history are most helpful. In gall-stone diseases, although the majority of the cases have no definite symptoms such as recurring jaundice, biliary colic, passage of stones in the stools, etc., the long history of digestive distress, independent of the taking of food and the comfort of an empty stomach, is suspicious. With these, a sense of constriction in the epigastric region may be described and a soreness and localized tenderness under the liver, these symptoms being accompanied with a sensation of chilliness or cold or nausea.

In subacute and chronic gastric and duodenal ulcers a long history of digestive distress may be present in which there is more or less pain in the stomach not relieved by eating or in fact not influenced in any way. No vomiting may be present and only an indefinite nausea, although a more or less degree of anemia or inanition usually exists. In duodenal ulcer the characteristic one- or two-hour pain after eating may not exist, and the form Mayo Robson described as "hunger pain" be present; in this the patient feels best when food is in the stomach and more or less constant taking of foods is required to limit or obviate the sensation. Also, the pain may not be present in the mornings, it coming on some hours after the midday meal and intensifying until about midnight. Unlike in gall-stones or pericholecystic adhesions, however, these patients are liable to have some degree of real anorexia, vomiting is more common, and the pain is described as nearer to the median line.

It must be mentioned that appendix disease may give but few local manifestations, most of the symptoms being referred to the upper abdomen and due to a reflex pylorospasm or hyperacidity. Also of much interest in this connection are the diagnoses of acute and chronic pancreatitis. In the sclerotic form a long history of digestive disturbance alternating with health, inability to digest certain kinds of food, and alternating diarrhea and constipation may be described. The acute form may be mistaken for perforative peritonitis or intestinal obstruction.

Regarding physical examination, a portion of an article of mine on the subject may be offered (Long Island Medical Journal, May, 1910) :—

"A patient who gives a suggested or definite past history of ulcer, who, after the acute symptoms have subsided, has a continuation of digestive distress, should be most carefully and exhaustively examined, and if nothing definite is found should again be placed on the rest and food treatment, and if after this the patient is not substantially improved the case is operative. With cases giving such a history of ulcer, the more or less constant presence of blood in the test-meals and feces, a stomach continuously intolerant to foods, evidence of delayed exit of foods from the stomach, or a stomach noted by X-ray to be globular (dilated) or showing irregularity in its contour, is operative from the beginning, it making no difference whether gastric hyperacidity, hypersecretion, subacidity or anacidity be found. Also, a patient in the empty stomach of whom are found small blood-clots, many leucocytes, a high bacterial content, and shreds of connective tissue, and the test-meal therefrom shows a high acidity and from

which, when the free HCl has been neutralized, a more than 2-per-cent gas result on standing twenty-four hours in an incubator is seen, means a greater bacterial content than a normal stomach should have, and high bacterial content fermenting the saccharides in the face of abundant stomach secretions in the organ most probably means latent ulceration and therefore is operative. We have no means of recognizing the early stages of a carcinomatous degeneration of an ulcer, and the fact that benign pyloric stenosis as well as simple chronic ulcer is often subject to cure by surgical procedure, when a pyloric stenosis exists operation is a perfectly justifiable procedure in every case that gives an early history of ulcer. But it is in those cases in which no ulcer history is obtained or suspected and those in which the differential diagnosis lies between anacidity, gastric neurosis and carcinoma that great care must be taken. In these, in my belief, we should hold off advising operation when no pyloric stenosis exists, and when it does or comes on, advise it in every instance.

"Whatever the diagnosis, or if none definite can be made, and providing it is not splanchnoptosis, a patient that does not improve on the most logical medical treatments for the condition, and particularly if the patient displays rapidly progressive loss of weight, strength, and asthenic blood change, that case is operative. If the diagnosis of hyperacidity or hypersecretion or atony had been made and the case does not improve in a reasonable length of time on proper medical treatment it probably is operative. In a general way, it should be remembered that the longer the history of digestive distress, the greater is the proportion of operative cases.

"If a mass is palpable in the upper abdomen, and it is not a loose kidney or liver, it is an operative case, but in a typical stagnant stomach giving an achylic return with lactic acid and many Boas-Oppler bacilli, the combination must be clinically looked upon as a questionable operative case of carcinoma of the stomach. In such an instance, the blood condition, rather than the general condition of the patient, should guide us. If the blood reduction in hemoglobin and erythrocytes be great, operation is liable to be fatal, and it is fairer to allow that patient to die in the few days that are left to him rather than add mutilation to his hopes raised by operation even if a gastro-enterostomy be successfully performed.

"A case of gastric distress, whatever the stomach diagnosis, which constantly has present a point of tenderness located definitely in the biliary triangle (which runs from the top of the ninth left costal cartilage to the umbilicus) or appendix region is medical for a month, and operative after that if substantial improvement had not been made.

Likewise, if a gall-stone case had recurrent attacks of biliary colic with jaundice, or if an acute attack of appendicitis with fever had been present the cases are operative at once.

"If the gastric distress comes on with or shortly following a deterioration in the general health the case is medical, and operative at once should a perforated gastric or duodenal ulcer be diagnosed or strongly suggested. Many surgeons recommend that in all cases that are suggestive of cancer of the stomach in which a diagnosis cannot be absolutely made the patient should be subjected to operation. With Kuttner, I am opposed to such a general rule. I recognize that there exist certain cases in which operation is advisable, but always about us are seen cases of gastritis anacida, gastric atrophy and neuroses in which no HCl is present, and certain of these and others have retardation of food from primary atony, and also must be mentioned the many that have secondary gastric conditions from functional and diseased conditions in other organs. In every one of them, operation would be criminal. On several occasions I have known of cases of late atrophic gastritis with nephritis operated upon by some of our best surgeons in the largest city hospitals we have for suspected gastric carcinoma, with the result that nothing was found and after which all but one of the patients died—was this right when the true diagnosis was so easy to be made?

"A nephroptosis with a freely movable kidney and in which Dietl's crises exist, is operative if the attacks do not cease after a month of treatment with support and constructive medical measures. When, even under apparently successful medical conditions, the seizures are followed with blood in the urine it is an operative case.

"A case in which the bowels have always been regular and in which constipation is rapidly becoming pronounced and leading to obstipation and the general body is failing, and there are not found definite medical reasons for this progressive constipation, is operative.

"A blow on the stomach or a fall from a height shortly followed by the vomiting or the passing of blood per rectum, and any abdominal wound that penetrates or perforates the abdominal wall are operative cases at the earliest moment.

"A case which presents a fixed mass anywhere in the abdomen is operative providing large doses of iodide of potassium do not cause its disappearance. Operation is indicated in post-operative abdominal conditions in which the vomitus or stomach contents obtained by tube display successively the constant presence of bile, pancreatic secretions and fecal substance; and in these cases it is best not to wait until the symptoms of collapse come on.

"An X-ray plate that shows a stricture of the colon, or when the feces constantly display the presence of blood and pus, and particularly if on digital and proctoscopic examination of the rectum nothing is noted to account for it, the case is operative. If a growth is noted in the rectum it is operative, but if rectal discharges are from a tubercular or syphilitic ulceration of the colon it is not.

"I wish to make a plea to general practitioners to seek the diagnostic help of the skilled internist earlier and in more of the patients that do not improve under treatment in his hands, and also to many of the internists to seek the help of the surgeon oftener than is now customary. The average surgeon is most respectful and does not look lightly upon diagnostic medical work that is well done, but most of that which comes to the surgeon is not thoroughly enough analyzed or deeply enough considered from the medical standpoint. More cases should go before the surgeon for exploratory incision to see why certain conditions are so, rather than for him to explore to see if something can possibly be found. Of course, there will always be some cases of the latter group, but if we all do better medical work, and work together more conjointly than we now do, these will not be as numerous as they have been. A most unfortunate fact lies in that enough cases are not exhaustively analyzed from the medical side, and in that many of the fine points of clinical procedure, readily at hand, are not utilized in the examinations. My experience and observations with the majority of surgeons I have come in contact with have been that, in a general way, surgeons have not the time, inclination, technical skill, deductive clinical ability, or temperament to diagnose those affections in the ways given to internists. The solution of this difficult subject will always remain where it should be—in the diagnostician's hands first, and, in my opinion, to minimize the dangers of mistakes, matters of surgical diagnosis should follow and not precede him."

In the work of such masters of the surgical art as Moynihan, W. J. Mayo, Finney, Mayo Robson, Hochenegg, Czerny, Helferich, Crile, Demoulin, von Eiselsberg, Hartmann, Kocher, Mikulicz, and the many others whose names for the moment I need not recall, the civilized and intelligent world owes an everlasting debt of gratitude. These men in the development of abdominal surgery have enlarged the therapeutic side of gastro-enterology to such an extent that many instances of permanent conditions and even malignant disease are rendered possible of palliation and cure by the hand of man. From a medical standpoint, they deserve more credit than only appears in the results they have gained, for in the course of the evolution of their labors they

have not been without enemies, some of whom, I am sorry to say, still hold too fast to fruitless or temporizing medical measures.

On the other hand, based upon the many glittering results that have been obtained by surgical procedures, a to some extent just as deplorable condition of affairs exists among part of the surgical ranks. Carried away by the enthusiasm of the subject, and by the brilliant reports of some surgeons, and wishing to do as well themselves, in the protection that aseptic surgery gives to them many surgeons look lightly upon the scope of the internist's ability to clinically diagnose conditions, or have insufficient time, practice, or ability to do this themselves, and thus reach too quickly for the scalpel for diagnostic purposes. On the clock of progress on the subject, the pendulum, which a few years ago marked an ultramedical consideration in which surgical intervention was rarely more than an emergency or an extreme measure, is now swinging ultrasurgically and some of the glittering results obtained are clouded with improprieties and unnecessary operations. I personally feel that it must swing back to a more proper equation between these two extremes. Excepting in such emergency conditions as penetrating and perforating gunshot or stab wounds of the abdomen, perforating ulcer, acute peritonitis, fulminating septic, perforating and gangrenous appendicitis, etc., a case should always be exhausted medically before it rightfully becomes surgical in nature—either because of the existence of a distinct surgical condition, or because the diagnosis is impossible to make in a medical way and the case warrants surgical intervention. Continued success in surgery is only possible by this medico-surgical combination, and it is my belief that it is largely due to the use of clinical diagnostic methods and their exhaustive employment by the most prominent surgeons that these men have reached the eminent standing that the results of their work justly deserve.

In this volume the author will give merely a short résumé of some of the well recognized types of operations employed, including the results from them that have been obtained by others and been observed by himself. The preparation of patients, operative technique, and the full consideration of the subject from a surgical standpoint can be found in works on that department of the subject. Not being a practical surgeon myself, I feel that I am not qualified to write upon it, particularly when I consider that, as often happens when the abdomen is opened and the pathological condition in each case is observed, so many modifications of standard operations or new ones for that particular case are indicated that to give a description of the standard operations alone would not be of much benefit.

### EXPLORATORY INCISIONS.

Parts of this subject were treated in the foregoing chapter and also in that on gastric carcinoma. Suffice it to say here that when properly performed the rate of mortality is so low that it may be disregarded because of the great benefit possible from directly feeling and viewing the internal structures. It might be said here that in each instance a complete or at least an adequate examination of all the parts concerned should be made, because small cicatricial areas in the stomach may be overlooked, an hour-glass stomach may escape recognition by the dilated pyloric pouch being mistaken for the entire stomach, one stricture of the stomach or intestine may be operated upon when multiple strictures are present (and so also with ulcers); a gall-bladder may be emptied of stones, leaving one in the common duct; an appendix may be removed leaving a much worse pathological condition in the intestines, pelvis, or elsewhere in the abdomen, and so on. A few extra moments spent in painstaking examination of all the parts affected, or likely to be, is often well paid for in the results. Every laparotomy carried on for a definite purpose is at the start exploratory in nature.

To make a statement as to which of the not surgically plain cases the internist should recommend for operation would call for an endless narration. As no two individuals in the world are absolutely alike in looks, form, or shape, so no two cases are clinically identical in nature. Because of the chronicity of many digestive disorders that are met with in which surgery can offer nothing to a patient beyond the moral effect of operation (which is a matter both the internist and surgeon should never take into consideration in any case), one should not be too hasty in endeavoring to clear up the situation. Much depends upon the history of the case, the character and complexity of symptoms, and the general condition of the patient; the last, in my opinion, is the most valuable guide to go by, unless such symptoms as exist make possible definite diagnosis of a serious condition for which surgery can do nothing. A close clinical study of each individual case will generally sooner or later direct one as to the proper course to pursue, and when in doubt and in the presence of a continually severe or progressive condition, particularly when abdominal pain is constantly present, a surgeon is often a most beneficial helpmate.

Adhesions are frequently encountered in abdominal operations. They are the result of inflammations, and, when they are attached to a movable organ like the stomach, they often are the cause of great distress and may have to be treated by separation and surgical attention. The results in the great majority of cases of perigastric adhe-

sions I have had operated upon have been only fair, particularly in those attached to the liver, diaphragm, and stomach. Where, after separation, the omentum could be folded over the roughened area the results were much better.

The term gastrotomy is applied to operations in which the stomach cavity is entered by incision, either for the purpose of exploration, as a preliminary to dilatation of strictures of the cardia, esophagus, or pylorus, to control hemorrhage within the stomach, for the removal of foreign bodies, polypi, and pedunculated tumors, or to bring the posterior wall into the field of surgery.

#### THE RESECTION AND PLASTIC FORMS OF OPERATION.

According to Deaver and Ashurst<sup>1</sup> these operations are described as follows: "The terminology employed by writers with regard to excision of portions of the stomach is not always uniform, and unless the terms used are clearly defined confusion is liable to arise. We employ the following terms to designate the operations. Sphincterectomy: By this we understand the removal merely of the pyloric sphincter, with end-to-end reunion of the duodenum and the stomach. It is an operation which in a few rare instances has been employed for benign fibrous stenosis of the pylorus, in which the pre-pyloric portion of the stomach was healthy.

"Pyloroplasty, we think, would be a less dangerous and quite as satisfactory an operation. By pylorectomy we mean removal of the pylorus; it is a more extended resection than sphincterectomy, but less so than partial gastrectomy, in which latter operation the entire lesser curvature of the stomach is removed. It is not always possible during an operation to determine the precise limits of the pyloric antrum; but, in general, we mean by partial gastrectomy an operation which removes, besides the pylorus, also the neighboring part of the stomach as far as the Hartmann or Mikulicz line, always including the whole of the lesser curvature. If the gastric area removed extends still further toward the fundus along the greater curvature, we speak of the operation as sub-total gastrectomy; while the term total gastrectomy is reserved for operations which leave behind no portion of the stomach, the upper section passing through the lower level of the esophagus, while the lower section, of course, divides the duodenum. Circular or cylindrical gastrectomy designates an operation by which the central portion of the stomach is removed, neither the pylorus nor the fundus being included in the section, although the lines of division extend from one curvature to the other and involve the entire circum-

ference of the stomach. By gastric resection we understand removal of a portion of the stomach not including the entire lumen of the organ; the term plastic resection we think therefore properly describes the operation called gastroplasty by Jedlicka; since in this operation, after resection of a portion of the anterior wall of the stomach, he reconstructs the organ by a plastic operation. Excision in connection with gastric operations we would limit to the removal of more or less circumscribed lesions or pedunculated tumors attached to or springing from the stomach." To the plastic operations may be added the invaginating operation employed for the closure of perforations, which, although not strictly plastic in form, is nevertheless plastic in nature.

The pyloroplasty operations now universally accepted as capable of the best results are the Finney modification of the old-fashioned pyloroplasty, the Y operation of Durante, and the Kocher method of lateral gastroduodenostomy. All three are valuable operations in suitable benign cases, and possess the advantage of relieving the stenosis by placing the outlet in a more natural location than the gastro-enterostomies. The terms gastroplasty, gastrogastrostomy and gastro-anastomosis have been given to the various types of operation performed on hour-glass stomachs; their choice depends upon the anatomical condition of contraction noted in each case. The term gastroplication is given to a tucking operation employed to decrease the size of large (atonic) stomachs, and gastropexy to an operation designed to fix a prolapsed stomach to a higher plane in the abdomen; both of these operations in practically all instances do not give the therapeutic results that the medical dōes, and, in my opinion, are unwarrantable surgical procedures.

#### OPERATIONS FOR "DRAINAGE OF THE STOMACH." GASTRO-ENTEROSTOMIES, AND STATISTICS OF OPERATIONS.

The pyloroplasty and gastroplastic operations for this purpose having been considered, there remains practically the two forms of gastro-enterostomy that are universally adapted. In these, because of the close anatomical proximity of its upper part to the lower regions of the stomach, the jejunum is employed to form the drainage canal from the stomach. With their modifications, there are two main types of this operation, the anterior gastrojejunostomy and the posterior gastrojejunostomy, the first being the joining of the jejunum with the anterior stomach wall, and the second with the pos-

terior. To these may be added the gastroduodenostomy operations wherein the stomach is joined with the duodenum—leaving the pylorus intact—either by joining elliptical slits in both organs, or by cutting the duodenum transversely and joining its entire lumen to the stomach, and lastly, the latter operation in which a pylorectomy is also done and the duodenum joined to the lower edge of the sutured stomach wound.

The various forms of gastro-enterostomy are short-circuiting operations and, like all such procedures, act best when a gross mechanical obstruction exists in the normal path of the stomach and intestinal contents. Experiments have shown that when the pylorus is normal, and there is no impediment to food within it, the opening made in the operation of gastro-enterostomy does not allow of the escape of any of the gastric contents into the intestine. For this reason, these operations should only be employed when stenosis exists in the prepyloric or pyloric regions of the stomach or in the duodenum, and not to establish better drainage to encourage healing of a gastric ulcer, unless in its repair or excision a surgical stenosis is formed, or, as was suggested before, a demonstrable organic stenotic lesion exists. An exception to the performing of a gastro-enterostomy in ulcer without stenosis exists in the long-standing, markedly organized ulcers with much formation of connective tissue, adhesions, and enlarged and engorged vessels in which excision or partial gastrectomy would be impossible or too dangerous. Because of the most troublesome surgical complication of regurgitant vomiting after gastro-enterostomies (due to the presence of a loop in the jejunum, or to a twist of the intestine around its longitudinal axis at the time of its application to the stomach), the posterior no-loop operation with the vertical suturing of the bowel to the stomach is the best procedure.

The results from these operations are often particularly brilliant. When performed on suitable cases patients gain in weight and strength, lose their epigastric distress, and often forget the previous constant indigestion. In their more comfortable existence, better metabolism and freedom from digestive disorder, the objections of many internists that the functions of the stomach are seriously interfered with by the operation are obstructive and senseless. The motor condition of the organ is most strikingly improved, and if bile, pancreatic juice, and the intestinal secretions are regurgitated into the stomach, it is comparatively a small matter when you consider that by the proper medical means these conditions can be successfully coped with. I do not believe that they should ever be performed in any case of primary excessive secretion even of the most persistent and

troublesome type, since proper medical measures long persisted in usually control the case in the end; nor in chronic ulcer should they be given the preference over the resection operations (simply for the good and valid reason that these ulcers may at the time or subsequently become malignant in nature). Quite logically in ulcer—the most common surgical condition of the stomach—the internal treatments should first be given a fairly long trial before operation is advised.

On the other hand, the clinical results from gastro-enterostomy are not always good even when performed for benign obstruction. In these cases the immediate mortality is about 10 per cent., about 30 per cent. eventually die or are not improved, about 2 per cent. develop cancer at some time afterward, and secondary operations are required in about 3 per cent. of all instances. In so far as gastro-enterostomy itself for these cases is concerned it may be stated that about 60 per cent. are either cured or much improved by it. In gastro-enterostomy performed for cancer the immediate mortality is high, usually about 35 per cent., while that done for ulcer is the lowest, around 3 per cent. It must be evident that the operation performed for cancer can only offer a short improvement in the local subjective symptoms and in a moral way. Recently I have advised its performance in a few cases of late cancer in which the mass was comparatively small and very hard, the history of its development rather long, and the general condition of the patient good enough to warrant its performance. But when the mass is large, the history of illness short, the general condition poor, and the hemoglobin and red cells low, no operation should be performed. In ulcer, when possible of performance, the excision forms of operation should always have precedence over gastro-enterostomy. Then, too, a gastro-enterostomy, which is not purely a mechanical process according to the law of gravity, but is mostly influenced by the physiological law of stomach movements, becomes impractical as an exit from the stomach in about nine months' time unless there is obstruction at the pylorus, when it may remain permanently open.

A word may here be said on the large number of postoperative and postanesthetic neurasthenia and psychoses cases I am to-day meeting with. Many cases of digestive disorder are neurasthenic in type, either primary or secondary, or combined as separate conditions. Excepting the secondary ones, and they are not as numerous as the other two, operation is liable to intensify, or actually bring out, a latent neurasthenia. Great care on the part of surgeons should be exercised that these individuals are not made worse by operation. An operation may relieve neurasthenic symptoms; it will not cure the patient, and there is a possibility that a few

months will see the patient worse than ever, having gained nothing but a new experience, and very likely an exchange of old symptoms for new ones. Reliable statistics show that over 11 per cent. of cases anesthetized or operated upon for any surgical condition develop neurasthenia, melancholia, and psychasthenia, and when these operations are laparotomies the percentage is distinctly higher. It is unfortunate that the statistics of some of our brilliant surgeons do not cover this phase of after-results.

In presenting the statistics of the best known abdominal surgeons on the various surgical conditions and the different forms of operations for them, the author has made an average deduction from all the statistics on hand. This seems to be a much more practical presentation than to detail the figures of the different operators. The published reports of the various surgeons often show a great difference, and no one or a few surgeons could operate on all of the cases that exist. Gastric carcinoma is a disease that is rather commonly encountered by most general practitioners of medicine, and ulcer perforation happens so quickly, the time for the operation is so short, and the danger of removal to a distance for operation so great, that the majority of the cases must be cared for by the local surgeons in each neighborhood. For these reasons, the author asks pardon for not including in the statistics the names of many of the well-known abdominal surgeons, and hopes that the general statistics included (which contain the most recent figures) may serve for better general guidance.

*Operations for Benign Diseases of the Stomach.*  
(14 Surgeons)

Number of Operations	Deaths	Mortality per cent.
1650	95	16.3

*End Results of Operations for Benign Diseases of the Stomach.*  
(8 Surgeons)

Cases Traced	Cured	
897	758	84.5 per cent.

*Results of Operations for Gastric Perforation.*  
(18 Surgeons including Hospital Records)

Cases	Recovered	Died	Mortality per cent.
215	115	91	42.3

*Results of Operation in Time After Perforation.*

Duration of Perforation	Mortality per cent.	
	Gross and Gross	Brunner
Less than 12 hours .....	25.00	25.00
Less than 24 hours .....	52.72	46.00
Less than 48 hours .....	56.06	58.00
More than 48 hours .....	73.91	80.00

*Results of Operation Within the First Few Hours after Perforation.*

(Gross and Gross)

Within the first five hours .....	31.03 per cent. died
Within the second five hours .....	16.25 " " "
Within the third five hours .....	42.85 " " "
Within the fourth five hours .....	54.00 " " "
Within the fifth five hours .....	57.14 " " "

In statistics covering more cases it will probably be found that the difference in figures between the second five hours as compared to the first five hours no doubt represents to a certain degree operations performed during shock. While in occasional favorable instances it may be advisable to wait until the symptoms of shock have subsided, because of the great uncertainty as to whether in any severe case the shock may be continued until too late for the possibilities of a favorable outcome from operation, and also because of the danger in waiting (irremediable peritonitis) it is best to have all cases operated upon at the earliest moment after the diagnosis of perforation is made. Most perforations are nearer to the lesser curvature than the greater, and in the pyloric region and duodenum. A word may here be included as to the advisability of doing a gastro-enterostomy when a perforation in the stomach near the pylorus has been repaired (often the pylorus seemed to be so narrowed by the stitches that doubt exists as to whether it would not be wise to cause better drainage of the organ in this way). My observation has been that even a thus much narrowed pylorus often answers for the complete recovery without a gastro-enterostomy being done, and because of this when local conditions are at all favorable I usually give the patient the benefit of the doubt, wait for recovery, and advise doing a gastro-enterostomy later if required. When there is evidence that more than one ulcer exists, even if the others have not perforated, and particularly when these are also observed in the duodenum, it is best to do a gastro-enterostomy at the time of the repair of the perforation (this, of course, assumes that the patient's general condition will stand it).

*Operations for Duodenal Perforation.*

(Robson's Compilation)

Time	Cases	Recovered	Died	Mortality per cent.
Under 24 hours	61	38	23	37.7
Over 24 hours	63	11	52	82.5
Not stated	31	3	28	90.3
	<hr/> 155	<hr/> 52	<hr/> 103	<hr/> 66.66

*Operations for Hour-Glass Stomach.*

(After Schomerus)

Cases	Recovered	Died	Mortality per cent
138	121	17	12.3

*Partial Gastrectomy for Carcinoma.*  
(25 Surgeons)

Cases	Deaths	Mortality per cent.
1009	237	23.4

Of these, about 25 were well three years after operation, and about 10 or 15 per cent. were permanently cured without liability of recurrence. (The value of an early diagnosis either by medical or surgical means or both together is apparent.)

*Gastrojejunostomy for Carcinoma.*  
(9 Surgeons)

Cases	Deaths	Mortality per cent.
645	184	28.5

Because of the lateness in the course of malignant disease at which the great majority of gastric cancers have been diagnosed, the above is often the only operation that can be performed. In the instances of these cases that have been operated upon which I observed, I have my doubts that the relief of symptoms and the prolongation of life from gastrojejunostomy have justified the performing of it. In the first place, the rate of mortality, because of the unfavorable local conditions in the stomach for the operation and reduced general vitality of the patients, is much higher than in gastrojejunostomy done for non-malignant conditions. Up to the date of writing, I have records of such instances with an operation mortality of 30 per cent., and I have not observed that, even in the hands of most abdominal surgeons who are well abreast with the advance that gastric surgery has made in recent years, this rate is being precipitately lowered. The effects of the operation on the relief of the subjective symptoms of distress and the improvement in the general condition were marked in only a few instances. The malignant growth being left in the patient, the pains are not lessened to a practical degree, and, because of the extension of the growth, the little benefit that comes from better stomach drainage is soon lost by the advance of the malignant disease and its constitutional effects upon the body. The ideal care of these cases is to diagnose them early enough for a complete removal of the growth, surrounding tissues, lymphatic vessels that drain from the affected area with their glands; an operation should be done if at all possible even if the danger of a fatal outcome from the operation is materially increased by the extensive removal; if this is not possible and the malignant involvement is not too extensive, an anastomosing operation may be done as a poor second choice; and lastly, if the malignant growth is quite diffuse in the stomach walls, or considerable involvement with the surrounding organs and

tissues is observed, or more or less of a metastatic condition noted in the liver and peritoneum, it is best to close the abdomen without further surgery.

*Operations for Gastric Sarcoma.*

(Lecène and Petit)

Cases	Recovered	Died
30	17	13

### OPERATIONS FOR ESOPHAGEAL DISEASE.

The operation of gastrostomy is performed in cases of impermeable stricture of the esophagus or malignant disease of the cardiac orifice of the stomach for the purpose of introducing food into the interior of the organ. There are a number of different methods for the purpose, but those of Senn and Witzel seem the most satisfactory since both answer the purpose and do not require much cutting of tissue to accomplish them. A suitable time should be selected for the performing of this operation, and this should not be too soon nor too late. This is judged by the factors present in each case, namely, whether the stricture can be kept patent enough by dilatation so that the individual can deliver enough food into the stomach to maintain his nutrition; if not, the operation should be performed before the reduction in vital strength and weight is too great to permit of surgical procedure. In the latter instance, a few patients can be improved in general condition and helped so that they can withstand the operation by passing a small silk catheter through the stricture (usually a very difficult matter), and by keeping the catheter constantly in place, and feeding the patient at intervals through it; a tube like this may be kept *in situ* for several weeks. The operation can occasionally be done under cocaine anesthesia in these commonly thin walled subjects, although, of course, general anesthesia is preferable. The operation has been performed in cases of diffuse peritonitis and phlegmonous gastritis, but usually without benefit. In my opinion, to perform gastrostomy for an esophageal obstruction in those who can swallow fluids painlessly is a needless, not to say, a cruel operation—except as a preliminary to a more radical procedure.

An operation for impermeable esophageal strictures has been devised by Abbe called the "string-cutting method." In this the esophagus is entered through an incision in the stomach by means of a filiform, a string is then drawn upward through the esophagus and mouth, and by dilatation with a Billroth bougie, or cutting the stricture by string sawing, the narrowing is enlarged in caliber. A gastric fistula is left so as to insure that feeding can be kept up, and the stricture is regularly dilated from above until swallowing is possible, after which the gastric fistula is closed. According to Abbe,<sup>2</sup> very

tight or impermeable strictures can always be safely, quickly, and permanently cured by gastrostomy followed by the string cutting. This operation should not be employed for esophageal strictures resulting from causes like presence of mediastinal tumors, aortic aneurism, and in malignant stenosis; in these the permanent gastric fistula free from leakage is indicated.

Recently a marked advance in thoracic surgery has been made possible by the use of one of the various cabinets in which positive or negative pressures or the use of the Meltzer method of active inflation can be kept up during operation. Sauerbruch, a pupil of Mikulicz, constructed the first negative air-pressure cabinet, making possible for the first time opening of the thoracic cavity without a resulting pneumothorax and collapse of the lung when the pleural cavity was entered. Since then numerous cabinets have been devised, and lately Meltzer discovered what appears to be the true physiological principle underlying respiration with the pleural cavity open. He suggested for these operations the use of a tube half the diameter of the trachea, the tip of which is placed near the bifurcation of the trachea and through which a continuous stream of air is run with a pressure of about 20 millimeters of mercury crudely obtainable with an ordinary foot-bellows. If a bottle of ether is placed in circuit with the air-tube, narcosis proceeds so nearly automatically that it requires but little attention. By the use of this simple apparatus, even with both pleural cavities laid wide open, the lungs remain distended and pink. The use of the Meltzer method is found to be practical in the human being, and no cabinet is required. It being a simple apparatus, it can be employed very generally, and it is now my belief that intrathoracic surgery will begin a development permitting of types of operations before only dreamed of. Already an operation has been proposed by Dr. Willy Meyer, known as esophago-gastrostomy, after intrathoracic resection of the esophagus, which renders possible relief of low strictures of the esophagus and of the cardia—structures which before this have been *noli me tangere*, at least by way of the direct route to the gullet through the thoracic wall. The operation is described in the Annals of Surgery, July, 1909, and has been performed successfully on dogs. As to its value in human beings, the only data on hand is that of one case of resection for carcinoma, and three of exploratory thoracotomies, but the operation seems a plausible one for selected cases.

#### REFERENCES.

- <sup>1</sup> DEAVER AND ASHHURST: "Surgery of the Upper Abdomen," vol. i, p. 390.  
<sup>2</sup> ABBE: Medical Record, Nov. 30, 1907.

## CHAPTER XVII.

### The Clinic.

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#### DISEASES OF THE MOUTH.

THE first step in the gastrointestinal examination of a patient is that of the mouth. Not only is this important for the recognition of diseases localized in or confined to the oral cavity, and the mouth manifestations of general morbid states, but it is valuable that the condition of the teeth, tender areas in the gums and hard palate, ulceration, etc., be observed because these may bear unfavorably on the treatment, or because incomplete mastication and insalivation of foods may be the cause of gastric distress and inimicable to relief of conditions.

In instances of disturbed taste, false teeth and plates should be removed and the points in the mouth they rest upon inspected and palpated. The sensation of taste should be tested in the accustomed ways (with salt, sugar, a bitter of some kind, heat and cold), the saliva should be tested for its reaction, starch-converting power, and quantity (this can be done by having the patient chew for a while on a piece of india rubber and collect the saliva in a vessel), and at times a bacteriological examination of the mouth serves to some practical purpose.

Being bacterial processes, carious teeth, alveolar abscesses, and ulcerative conditions of the gums may lead to disease by the swallowing of pus containing toxin and bacteria, or by the direct absorption of these into the lymphatic structures about the mouth from which they may finally gain access to the general circulation (therefore the importance of removing enlarged tonsils in the adult as well as the child). According to Hunter, oral sepsis is a factor of great importance in the pathogenesis of pernicious anemia. While there is always a doubt in the causation of any disease the etiology and pathology of which is so little known as pernicious anemia, still, I believe that the anaërobic bacteria so commonly found in large numbers about the teeth in neglected and diseased mouths and also in the intestines and feces from these cases have more than just a suggestive connection between the two. Particularly is this logical when one considers that these patients usually have an anachlorhydric stomach, and that daily colonic flushings (either per rectum or subsequent to the performing of an appendicostomy) often bring most gratifying clinical results. As a rule, the general practitioner pays too scant attention to the condition of the



Fig. 99.—PYORRHEA ALVEOLARIS (RIGGS'S DISEASE).

- A*, An incipient case. Symptoms: Bleeding, spongy and receding gums.  
*B*, More advanced case. Symptoms: Pus discharge and marked recession of gums.  
*C*, An extreme case. Symptoms: Copious flow of pus, teeth exceedingly loose. Serious disturbance of the digestive functions from defective mastication and continued ingestion of pus.

teeth, and it is true that proper dental conditions very often bring about an improvement of digestion, and in this way improve the status of general health. It is also most probable that the minimizing of the element of swallowed infectious material when the hygiene of the mouth has been cared for has much to do with this.

The great importance of the preservation of the teeth is now recognized by all persons of intelligence. Crowding together of the teeth in the jaw and irregularities and depressions in the individual teeth are causes of dental caries. A direct and exciting cause is the lodgment of particles of food between the teeth and in the depressions on the surfaces. These particles of food undergo fermentation, with the production of bacteria and acids which attack and destroy the enamel of the teeth and then cause caries of the body of the teeth. Not all food is equally injurious in this way. It is chiefly the carbohydrates, the starches and sugars, which undergo this acid fermentation. The proteins, on the other hand, do not undergo the same acid fermentation and, consequently, they are less injurious.

It is evident, therefore, that in order to prevent dental caries it is necessary to prevent the stagnation or lodgment of the starches and sugars of the food in the mouth, and particularly in, on, or between the teeth.

The decomposition of the food lodged in the mouth commences very quickly, and therefore the rule of thoroughly brushing the teeth after each meal should be observed by every member of every household. The best instrument for this purpose is an old-fashioned toothbrush made of hogs' bristles. The bristles should not be so stiff as to injure the gums, and yet stiff enough to thoroughly remove all foreign matter from between the teeth. Neither a wooden (the best toothpick) nor a quill toothpick, nor silk floss, nor a napkin or towel, nor a rubber toothbrush can accomplish this purpose nearly so well as a toothbrush of bristles.

Even with the greatest care it is extremely difficult to keep the teeth entirely clean, and the majority of people are careless in the care of their teeth. Consequently, it is of great importance to arrange the food so as to diminish the tendency to the lodgment of the starches and sugars of the food between the teeth. These deposits are often caused by eating foods in a soft, moist, and mushy condition, and especially by eating them at the end of the meal. On the other hand, there is less tendency to this stagnation of the food around the teeth if the food eaten is dry, fibrous, and coarse, so as to require prolonged mastication. Incidentally this prolonged mastication of hard foods, in children, tends to strengthen the teeth and develop the jaws, so that they become larger and broader, affording more room for and less crowding of the teeth.

The things to be remembered in the care of the mouth and teeth may be summed up as follows:—

1. Theoretically water should follow the milk of bottle-fed babes.
2. A soft cloth should be thoroughly moistened with a mild alkaline wash and frequently applied over the first teeth of the infant.
3. No candy, or at least but little, should be given to young children, and as soon as their teeth have erupted they should have the more crunchy or granular cereals, and not so much of the soft, gelatinous cereals.
4. The teeth should be regularly cleaned by a dentist, at least once in six months.
5. All cavities, even small, should be filled, at least with temporary filling, so that the first teeth may be preserved as long as possible in order to develop the jaws properly, so that the second teeth need not be crowded.
6. The teeth of children and adults should be thoroughly brushed at least twice a day, better three times, with a proper brush, and, at least in the morning, with a tooth powder that is not too soapy, and at night with an alkaline mouth wash.
7. All persons, growing children or adults, should have all the tartar that may become deposited cleaned from their teeth once in three months, and examinations of the teeth once in six months will disclose cavities before they have become large ones.
8. If the teeth tend to degenerate and cavities form quickly, the trouble is generally with the nutrition, and the person is often deficient on bone-forming salts. Such patients should receive lime salts, phosphates, glycerophosphates, and iron.

There is such a large choice of official preparations to meet this need that there is no necessity for prescribing proprietary preparations. The number of preparations of the United States Pharmacopeia and National Formulary may be enumerated as:—

Calcii hypophosphis, dose 0.50 gram ( $7\frac{1}{2}$  grains).

Syrpus hypophosphitum, dose 1 to 2 teaspoonfuls:—

This contains calcium hypophosphate, potassium hypophosphate, sodium hypophosphate, dilute hypophosphorous acid, sugar, tincture of fresh lemon-peel, and water.

Syrpus hypophosphitum compositus, dose 1 to 2 teaspoonfuls:—

This contains calcium hypophosphate, potassium hypophosphate, sodium hypophosphate, ferric hypophosphate, manganese hypophosphate, quinine, strychnine, sodium citrate, dilute hypophosphorous acid, sugar, and water.

Elixir calcii hypophosphitis (N. F.).

- Liquor hypophosphitum (N. F.).
- Liquor hypophosphitum compositus (N. F.).
- Syrupus calcii hypophosphitis (N. F.).
- Syrupus calcii et sodii hypophosphitum (N. F.).
- Syrupus phosphatum compositus (N. F.).
- Elixir glycerophosphatum (N. F.).
- Elixir hypophosphitum (N. F.).

The noting of the breath is a clinical observance of no mean importance. It must not be considered an inelegant or dangerous procedure on the part of physicians to be deliberate in this way. In this connection, I personally feel that we may learn much from the older clinicians who, in their work, depended more upon impressions gained by the five senses than we do to-day with the more modern methods of examination at our command. Among the observations I have made are, that a sweetish breath is commonly observed in diabetes mellitus and occasionally in chlorosis, and that in the first mentioned disease when an acid intoxication exists this quality of the breath is most marked (fruity). In septicemia a somewhat similar odor exists, which may be described as less pronounced (in many cases, however, no change from the normal can be noted). A urinous odor is found in uremia, and the offensive odor following the abuse of alcoholic drinks is well known.

An offensive breath is observed in some cases of constipation where there is much fermentation and putrefaction in the gut, in diverticulum or other retention conditions of the esophagus, in some cases of gastric atony when stagnation with sulphurated hydrogen production is present, in cystitis with ammoniacal decomposition of the urine, with plugs in the crypts of the tonsils, in carcinoma of the tonsils, pharynx, and larynx, and in the serious lung conditions, namely, phthisis with cavities, pulmonary abscess, and gangrene. Lastly, may be mentioned the ulcerative and inflammatory conditions about the mouth, and neglect of dental conditions and hygiene of the oral cavity.

The important point in the treatment of offensive breath is to determine and remove the cause. There are, however, many instances of persistent offensive breath for which a definite cause cannot be assigned. In these unfortunate individuals (most of whom in my experience have been women) I believe the condition is intestinal in origin, and the foul breath is due to a resorption of aromatic substances from the bowel and their elimination from the blood in the expired air. I have noted on a number of occasions that when there was a congestive or catarrhal inflammatory process in the gut a foul breath was often present. For instance, in women who are about to or who are men-

struating, a temporary foul breath may exist, and this is probably due to the congestive condition in the pelvis and lower abdomen incident to the process which causes a higher degree of resorption. In the persistent form of offensive breath when no other cause can be assigned, I have noted that the best results come from the use twice weekly of oleum ricini, a lowering in the proteid foods, the steady administration of a gentle laxative or daily irrigations of the colon, and the drinking of considerable water between meals. After all meals the mouth should be thoroughly rinsed with plain warm water or an antiseptic mouth-wash, and the use of the following formula of Miller's may be of service:—

B Acidi benzoici .....	6.0	Jiss
Olei menthae piperitae .....	1.0	mxv
Tinctura eucalypti .....	30.0	f8j
Alcoholis absoluti .....	100.0	f5iiiss

Misce et sig.: Use night and morning as a mouth-wash, using a toothbrush to cleanse the teeth.

Changes in the lips possess a clinical significance in several important ways. In health the lips are naturally of a bright red color, often observed deepest at the margin of contact. They are observed abnormally pale (also the oral mucosa) in anemia, hemorrhage, chronic parenchymatous nephritis, and in aortic stenosis. While this pallor is of value as a clinical sign in the diagnosis of anemia, it must not be forgotten that a rather deep red color to the lips may exist in the presence of anemia; although usually in these instances the vault of the mouth and faacial mucosa are paler than normal. In this connection a word may be added as to the diagnostic value of the color of the tarsal conjunctiva. When the lids are free from local disease (trachoma, folliculitis, acute catarrhal process), this sign is of some clinical value, but these local conditions are so common, particularly among the poor, that but little dependence can be placed on the depth of color (the lower lids being the ones usually observed are also the ones most often affected). In cancer of the alimentary tract and in diabetes a deep-red color to the lips is occasionally seen, and in jaundice a yellow tinge to the inner surface of the lips and buccal mucosa is the rule. Deposits of lead in the lower lip with a blue line at the gingival margins may be noted in chronic lead poisoning, and in Addison's disease the presence of brown patches on the lips, inside of the cheeks, and palate is a most important diagnostic sign. Cyanosis of the lips may be observed in pneumonia, emphysema, in congenital and acquired heart disease, mediastinal tumors, rupture of an aneurism into the superior vena cava, polycythemia, intestinal toxemia, and in poisoning with coal-tar products. Riesman mentions

a case of enterocolitis in which enterogenic cyanosis was always preceded and accompanied by intense blueness of the lips. Among the other conditions affecting the lips may be mentioned the vesicles of herpes seen in infectious colds (influenza, streptococcus infections), lobar pneumonia, malaria, angioma, carcinoma and lymphangioma; and Baelz's disease, which is a chronic inflammation of the mucous glands accompanied with ulceration and enlargement of the lymph-glands and constitutional symptoms (the latter disease is most probably infectious in nature and rapidly responds to topical applications of tincture of iodine to the ulcers).

Among the disturbances of sensation of the tongue and mouth may be mentioned anesthesia, hyperesthesia, paresthesia, and ageusia.

Anesthesia is usually of hysterical origin, extends into all qualities of disturbed sensations, is usually unilateral but may be complete. When a lesion exists in the inferior maxillary nerve, the tympanic plexus, or cerebrum the resulting sensory disturbance is always unilateral, and when of central origin is generally part of a hemianesthesia (one-half of the body). Hyperesthesia is more commonly encountered in the various forms of local inflammatory processes in the mouth, and paresthesia (pricking, tingling, formication), in the general neurological affections. Of the latter may be mentioned particularly hysteria, central lesions of the nervous system such as apoplexy, and more often neurasthenia and psychasthenia. Ageusia is to be expected in dryness of the mouth, such as with typhoid tongue and mouth breathing. In ageusia limited to the anterior one-third of the tongue, the lingual nerve or the chorda tympani is involved. In general anesthesia of the mouth, ageusia may also be present, and in hyperesthesia a hyperageusia is the rule; the latter conditions are found in their most complete form in hysteria. In this disorder, in the insane, as an aura in epilepsy, in some cases of facial palsy from chronic ear disease, and in digestive disturbances, parageusia (gustatory in origin) may exist. In the digestive disorders, sweet, metallic, salty and bitter tastes are commonly complained of. Many of these no doubt have a reflex origin, although local conditions in the mouth and the taste of eructative discharges from the stomach account for many of them.

Of the inflammatory conditions about the mouth (stomatitis) may be mentioned the catarrhal, aphthous, ulcerative, specific infective, the gangrenous forms, and smooth atrophy.

The catarrhal cases are most commonly met with in clinical work. There is usually seen a redness and swelling of the mucous membrane, accompanied with an increase of saliva and bacteria and an offensive breath. The condition is most often local in its nature, although it is

found as an accompaniment to the infectious diseases (scarlet fever, influenza, measles, variola), in digestive disorders and depressed states of the general system, and after the use of certain drugs (mercury, iodides, lead, arsenic, etc.). The local conditions in which it is seen are those caused by the taking of irritating foods, drinks, and medicines, in tobacco users, in abnormal dental conditions, and in those who do not take hygienic care of the mouth. The removal of the cause, the thorough cleansing of the mouth after meals, and the use of an antiseptic mouth-wash or rinsing the mouth with a weak solution of glycerite of tannic acid (1 teaspoonful to  $\frac{1}{2}$  a glass of warm water) usually correct the condition in a short time.

Aphthous stomatitis is more particularly met with in children during the period of first dentition. Usually in only small areas of involvement the condition is seen in adults for about the same reasons as are mentioned in the catarrhal form. Most of the laity believe that the condition is due to some digestive disorder, and in this I also concur. My reasons for this are that as yet no specific organisms have been found in the cream-white adherent or more or less detached plates of mucous membrane and small, round, discrete ulcers, and that purging the patient and correcting an intestinal disorder are as necessary in the treatment of marked cases to cure the conditions as are the local treatments. The ulcers are usually small with a slightly elevated red border and are found in the inner and lower surface of the lips, in the labiogingival pouch, the under surface or at the tip or margins of the tongue, and are usually exquisitely painful for their small size. Salivation from mouth irritation is generally present, the tongue is coated, the breath is offensive, and a slight degree of fever may be present. The treatment consists of drying, cocaineizing and thoroughly touching the spots with a stick of solid silver nitrate, and the correction of such general or digestive disturbance as may be present; for the latter a dose of castor oil followed by tablespoonful doses of rhubarb and soda mixture after meals are valuable; often the general tonics are also of service.

Ulcerative stomatitis (putrid sore mouth) is the term given to those conditions in which the general state of the mouth is more severe than in the above in that the ulceration is a more prominent feature. The ulceration, however, is more on the confluent order, and usually begins in the gums at the dental margins. The entire extent of gums becomes involved, swells, bleeds easily, ulcerates, and becomes necrotic. The ulceration may eventually extend to the lips and buccal surface of the cheeks. Salivation is profuse, and the breath most offensive. Mastication is painful, the sense of taste is impaired,

there may be fever, and from interference with the taking of food, some emaciation. The condition lasts for from a few days to several weeks, is not fatal in nature, and responds well to treatment. Etiologically speaking, no specific cause has been ascribed for the condition. My belief is that a general cause, such as scurvy and other blood dyscrasias, salivation from mercury (ulcers here are usually on the buccal side of the cheeks opposite the molars), pneumonia, chronic nephritis, hepatic cirrhosis, etc., render the mucosa and tissues of the mouth liable to marked local infections from the mouth bacteria. The fusiform bacillus of Vincent (anaërobic) and the spirochetes are most often associated with the condition. The treatment consists of the use of the strong antiseptic washes (hydrogen peroxide, weak phenol solutions) and the topical use of a silver nitrate solution or tincture of iodine. The general condition of the body should receive proper attention, and such cases as develop in hospitals or institutions (usually children in an asylum) require better hygienic conditions. In the case of mercurial stomatitis the administration of the drug should be stopped, tonics given for the time being, and a mouth-wash prescribed.

Gangrenous stomatitis (*noma, cancrum oris*), while formerly quite common, is rarely met with to-day. It is most often seen in children following the infectious, contagious and communicable diseases, and is most probably due, like the above, to a combination of reduced general health and mouth infection. The process is usually located in the cheek or lip, and manifests its presence by the integument over the area becoming swollen, glazed, colorless, and hyperesthetic. Following this an ulcer appears on the mucous surface which rapidly becomes gangrenous and advances outward to the integument. In severe cases the tongue and palate may become affected. The odor is most fetid, and the submaxillary lymph-glands are usually enlarged from toxic absorption. The treatment is essentially surgical and antiseptic, to which stimulation, forced feeding, abundance of fresh air, and tonics are added. Generally the younger the child and the more extensive the involvement, the more fatal is the issue, most of the cases dying from exhaustion, emaciation or end infections.

A smooth atrophy affecting mostly the base of the tongue may be seen in tuberculous cases and in association with general wasting states, but its greatest clinical significance is in connection with syphilis. The atrophy usually extends from the circumvallate papillæ to the tongue at the base, the oral part of the tongue not being much affected.

Concealed oral sepsis is important as a cause of depraved and debilitated general states of health and body, rises in temperature, and various states of complaint, most common among which are, irregular

forms of rheumatism, myositis, polyarthritis, lumbago, neuralgias, etc. No examination of the mouth in people over 35 years of age who have teeth is complete without an X-ray examination of the tooth-roots.

Among the other conditions of the mouth are thirst, herpes buccalis, glossitis, Riggs's disease, gonorrhreal stomatitis, tuberculosis, carcinoma, actinomycosis, cysts, lupus erythematosus, urticaria, syphilis, the mouth lesions of lichen planus, pemphigus, eczema seborrhœicum, erysipelas, and scleroderma. The oïdium albicans, the etiological organism in thrush, is easily observed by examining a bit of the infected membrane microscopically, when the two forms of



Fig. 100.—Showing clinical appearance in a case of lingual tuberculosis.  
(Trimble).

the organism will be seen as small, yeast-like bodies (spores) and long, branching, band-like formations which present distinct segments (fungus); drying, fixing and staining of the specimen are not required. In herpes the vesicles are usually on the outer surface of the gums and on the dorsum of or under the tongue. In searching for the specific organisms of the other infectious conditions it is advisable in cases of lupus to search for the tubercle bacillus in superficial or deep scrapings of the ulcers; and in actinomycosis in the contents of the typical kernels, which must be opened for the purpose. In Vincent's angina, smears from the exudate (dried, fixed, and stained with carbol fuchsin 1 to 20, Löffler's blue and gentian-aniline water) show these as spirilla usually presenting 3 or 4 convolutions (in fresh wet-stained specimens they are actively motile) and a fusiform, non-motile bacillus. The same organisms may be found in normal individuals and other mouth conditions than

Vincent's angina, but not in large numbers. A more extended description of the common bacteria of the mouth is found in Chapter II.

#### DISEASES OF THE SALIVARY GLANDS.

Glucose in the saliva is found present in about one-half of the cases of diabetes mellitus, and in grave forms of nephritis and uremia urea in increased amounts is even more commonly found. What concerns us particularly here are the distinct conditions pertaining to the salivary glands and their secretions, as these have a direct bearing on digestive disorders.

Conditions of hyperptyalism are by far more often diagnosed than hypopytalism or even aptyalism. The reason for this is that in the first-mentioned condition the patient usually draws attention to the excess secretion, while with diminished or absent secretion direct examination is usually required to reveal the trouble. Among the conditions in which an increased secretion of saliva is noted are the inflammatory mouth disorders, already described, and dentition; as a reflex in excessive gastric juice secretions (hyperchlorhydria, gastric ulcer); trigeminal neuralgia and pregnancy; from direct stimulation, such as in hysterical and neurotic salivation; and from drugs, such as mercury and pilocarpine.

While not a convert to the latest fad for the cure or prevention of digestive disorders (the so-called Fletcherism), I wish, however, to state that enough attention to the subject of thorough insalivation of foods and tests for the amylolytic power of saliva has not been paid by medical practitioners in the care of digestive disorders. Considering the subject from the standpoint of digestion, gastric distress can ensue from what may be termed a relative hypopytalism—that is, where the salivary secretions are normal, but from hasty eating only small amounts of the secretion reach the stomach, and thus only a slight conversion of the starches takes place in the fundic and axis areas of the food in the stomach. The starches make up a large bulk of our foods, and unless enough conversion takes place before saturation with the hydrochloric-enzymotic secretion (which inhibits its digestion) *bona fide* fermentative states, with excess gas formation, are liable to occur. If this becomes a long-standing habit, the salivary glands (from lack of function) to a great extent lose their secreting power, and for this reason the subject and the digestive power tests of the saliva are important.

Rather commonly in neurasthenia, psychasthenia and other general neurotic disturbances of the functional forms, a hypopytalism exists. In fright, suspense, worry, grief and anxiety, the salivary secretion may also run low, with or without a corresponding change in the hydrochloric acid secretion of the stomach. The therapeutic

indication is logical here, namely, measures for the correction of the nervous disorder, more thorough chewing of the foods, the taking of less fluids with the meals, possibly the partaking of less starches, and the use, for a short time after meals, of chewing gum. Care must be taken when advising the employment of the latter that a prescribed limit of time for its use be given, because patients are liable to become habituated to its use, and chewing it between meals, with the swallowing of much saliva into the empty organ, often causes a degree of anorexia and general gastric distress. Diminished salivary secretion occurs in connection with the infections or continued fevers (pneumonia, typhoid) which deprive the body of its fluids, and likewise in diarrhea, pyuria, and tapping of dropsical accumulations. Hypoptyalism is not uncommon in arteriosclerosis, and an aptyalism is to be expected in those rare cases of atrophy of the salivary glands. Under the name of xerostomia (dry mouth) Hutchinson has drawn attention to a distressing continued dryness due to suppression of the salivary secretion, which condition most probably is part of a neurotic disturbance. These cases usually resist treatment, yet often recover in the course of time; but when true atrophy of the salivary glands has taken place it may go on to a fatal issue. A case of this kind I had under observation some years ago, in a man 41 years of age, who finally recovered on large doses of strychnine, continued for more than two months with daily hot baths and living during that period in a nearby health resort.

True atrophy of the salivary glands is a rare occurrence. More or less senile atrophy occurs in advancing age, but there is an atrophy of obscure origin which may affect any one or all of the salivary glands in middle age. The condition is observed by an unnatural smoothness of the floor of the mouth, a hollowing and wrinkling of the integument over the site of the parotid glands, and the complaint of excessively dry mouth. On the other hand, a symmetrical enlargement of the lachrymal and salivary glands (Mikulicz's disease) may exist with little or no effect on their secretions. The condition is probably not a clinical entity, but one due to a lymphoid hyperplasia from causes of a general toxic, infectious (tuberculosis), or blood dyscrasia nature (leukemia, pseudoleukemia, atypical lymphomatosis of a sarcomatous nature). For the treatment of this condition the use of the X-rays has been advised (Pfeiffer).

Zagari described a case of functional disturbance of the salivary glands. The patient was a woman, aged 50 years, who suffered from an increasing dryness of the mouth until the secretion of saliva entirely ceased. The immediate results were, of course, manifest in the processes of mastication, deglutition, and articulation.

**Congenital Malformations.**—Malformations of the gullet are not very common. Instances have been reported of congenital stenoses existing at various points from the pharynx to the cardia, an opening of the upper or lower end of the esophagus into the air passages, and an instance of two gullets existing side by side. These are of embryonic origin, arising from the fact that the pharynx and esophagus have a common origin and that adventitious formation may occur.

#### ESOPHAGEAL DIVERTICULA.

The malformations of the gullet often met with are diverticula, which consist of pouches in the wall that connect with the lumen of the viscus. There is still some question as to whether these are congenital in origin, due to defective fusion of the muscle coats of the two sides at the median line posteriorly, and when lateral from lack of obliteration of the branchial clefts, or whether they develop during life from internal pressure—"pressure diverticula," or "traction diverticula" when the force is exerted from without. Pressure diverticula, which make up the great majority of cases seen, are usually found in the posterior wall, high in the gullet. They are caused by the separation or rupturing of the muscular fibers, at which site a bolus of food causes a hernial sac to form. The sac usually consists of thickened mucous membrane, submucosa, and fibrous tissue, although a few muscle fasciculi may be present in the wall. They may be single or multiple, small or large in size, and pedunculated with a slit opening or globular with a wide opening. They are more often found in the male in middle or advanced life, and are liable to escape clinical recognition and their presence first be noted at autopsy, although when situated in the thorax, and large in size and under conditions of high intra-esophageal pressure, the sac may rupture, with serious results, such as aspiration pneumonia, phlegmon secondary to perforation, and perforation into the air passages.

In the traction form, a funnel-shaped diverticulum is usually found anteriorly on a level with the tracheal bifurcation. These often seem to be due to involvement from the large lymph-gland at that site and which commonly is infected with tuberculosis, causing periglandular inflammation.

**Symptoms.**—The great majority of both pressure and traction diverticula, being small in size, give no symptoms and are not diagnosed during life. If the sac be large enough to hold fluid or food material, its decomposition takes place, local irritation is produced with sternal burning and pain, a constant feeling of a foreign body in the throat, vomiting of the contents of the sac, difficulty in swallowing

PLATE LV.



Diverticulum of the esophagus. The anomaly was on the left and about one-third the way down the esophagus. Its diameter readily admitted the tip of the index finger, and extended downward about one inch outside of the gullet. The patient had no knowledge of its presence (it had never given him any symptoms of its existence during life) and it was disclosed at post mortem.

on the gullet, and disturbance in free respiration surrounding tissues without the canal. When foul breath may be noted, and an esophagitis result in ulceration and perforation. In this abscess may develop and the pus may or into the thoracic cavity, causing A tube and bougie usually pass a when the opening is small and the opening and the sac are be diverted into it, its contents of the sac before its tip has the sac of decom- in it are the distinctive If the sac is in the lower may be used to palpate it; if lower the lateral aspect of the root of the may be produced. This is best sought for most likely to be empty, i.e., the early morning. ant drinks as much water as he conveniently can, examiner's ear is placed close to the patient's neck or the be placed at the root of the neck on the left side and nx is grasped by the hand and the neck vigorously nt holding his breath and not swallowing during the some cases one can readily hear the splash of the fluid dry creak or rattle heard and felt while shaking the ad aged people must be differentiated from the splash—eing a simple matter. Even when the sac is large and on the esophagus, should it be filled with the water or not the splash may not be present. An esophagoscope or d the X-ray and bismuth method of diagnosing may be lower down. Rather than use a stomach tube the second icious case (because one is liable to rupture the sac, which these latter measures should be employed.

**Diverticula.**—Small diverticula which cause no trouble might best be 1. When they are large enough to cause symptoms, both id objective, they are operable cases. In bad cases feed- a tube may be practised for a while to build up the length to withstand the operation, which in each instance be a severe one. Rectal feedings may also be employed. 1 the usual way is allowed, the foods should be semisolid 1 only a small quantity swallowed at any one time. Regular



from pressure of the sac on the gullet, and disturbance in free respiration from pressure on the surrounding tissues without the canal. When retention of food exists, a foul breath may be noted, and an esophagitis may develop, which might result in ulceration and perforation. In this latter instance, a peri-esophageal abscess may develop and the pus may empty into the gullet with recovery, or into the thoracic cavity, causing empyema and gangrene of the lung. A tube and bougie usually pass a small diverticulum, and also a large one when the opening is small and the sac is more or less collapsed. When the opening and the sac are large and distended with contents a tube may be diverted into it, its further downward progress being stopped, and the contents of the sac aspirated. The arresting of the tube in the course before its tip has reached the stomach cavity and the aspiration from the sac of decomposed fluid or food without stomach secretion in it are the distinctive points in the diagnosing of the condition. If the sac is in the lower pharynx or upper gullet the finger may be used to palpate it; if lower down a bulging may be noted in the lateral aspect of the root of the neck. A succussion splash may be produced. This is best sought for at a time when the sac is most likely to be empty, *i.e.*, the early morning. To obtain it, the patient drinks as much water as he conveniently can, after which the examiner's ear is placed close to the patient's neck or the bell of a stethoscope placed at the root of the neck on the left side and the patient's larynx is grasped by the hand and the neck vigorously shaken, the patient holding his breath and not swallowing during the examination. In some cases one can readily hear the splash of the fluid in the sac. The dry creak or rattle heard and felt while shaking the larynx of thin and aged people must be differentiated from the splash—this, however, being a simple matter. Even when the sac is large and freely movable on the esophagus, should it be filled with the water or not contain enough, the splash may not be present. An esophagoscope or gastroscope and the X-ray and bismuth method of diagnosing may be used for those lower down. Rather than use a stomach tube the second time in a suspicious case (because one is liable to rupture the sac, which occurs easily), these latter measures should be employed.

**Treatment.**—Small diverticula which cause no trouble might best be left untreated. When they are large enough to cause symptoms, both subjective and objective, they are operable cases. In bad cases feeding through a tube may be practised for a while to build up the patient's strength to withstand the operation, which in each instance is liable to be a severe one. Rectal feedings may also be employed. If feeding in the usual way is allowed, the foods should be semisolid in nature and only a small quantity swallowed at any one time. Regular

washing of the esophagus with water assists in preventing the decomposition of food and thus maintains the health and tone of the viscus.

#### ACUTE ESOPHAGITIS.

Primary inflammations of the esophagus no doubt are of much more frequent occurrence than are diagnosed. They can occur from mechanical, thermal, or chemical irritation of swallowed substances, of which too hot liquids make up the largest bulk of the cases. The esophagus may be secondarily affected with acute inflammation in inflammatory disease of the mediastinal tissues, from extension of inflammation from the pharynx (rare), as an accompaniment to the various acute diseases, such as diphtheria, scarlatina, variola, measles, typhoid, pyemia, pneumonia, thrush, and in cancer of or near the tube.

According to the severity of the process, the degrees catarrhal, follicular, ulcerative, phlegmonous, and necrotic inflammations are recognized. In the ordinary catarrhal form the mucous membrane is reddened from congestion of the mucosa and submucosa, a slight desquamation may be seen, and there is usually an excess of secretion. The follicular variety, in my opinion, should be considered as a distinctive type of disease in which an inflammation of the lymphoid and mucous glands takes place. The glands involved in the mucoid degeneration are usually the mucous ones in the upper part of the tube, a condition which may result in retention cysts, or when infection and strangulation of the circulation by surrounding inflammation take place, ulcers and perhaps abscesses may then ensue.

After the drinking of lye solution or other corrosive poisons large pieces of the mucosa may be shed and brought up in the vomitus. When the action of the poison is slight, roughened areas of membrane may be seen, and when severe a deep slough may take place, leaving a hemorrhagic and inflamed base. In these instances, if death does not occur from shock or the chemical action of the poison, rather extensive esophageal suppuration and ulceration often occur, the healing of which is attended with the highest degree of stricture. Ulcers of typhoid fever are occasionally found in the gullet, and in variola discrete, small-sized, suppurative areas may be encountered.

**Symptoms.**—In cases due to poisons the inspection of the mouth and pharynx generally makes the diagnosis clear. There is usually severe pain in the course of the gullet, with substernal distress, made definitely worse upon swallowing. Dysphagia and expectoration of mucus are present and also extreme thirst. In other cases, even severe ones, the pain may be dull, or even not present at all. The main symptom in esophagitis is the increase or the incidence of pain in the swallowing of

hard, dry foods or very hot or very cold fluids. The passing of tubes or bougies is distressing and rather dangerous because of the possibility of perforation or infection. Such symptoms, more or less severe, coming on after the history of a cause for the production of an inflammation or during the course of an infectious disease, are always suspicious of an esophagitis. If a foreign body lodged in the canal causes the inflammation, regurgitation of food, blood, and pus may occur. If the involvement be severe and low in the gullet, perforation is liable to take place, with escape of infected fluid into the trachea, bronchus, or the chest cavity.

Treatment.—In the severe forms (poisonings), the antidotes and emollient drinks are indicated, and olive oil containing one of the insoluble bismuth salts in suspension may act as an efficient sedative to the inflammations in the milder cases. The dissolving in the mouth of small bits of ice may be tolerated for a short time, and ice bags or hot applications to the stomach, back, or neck may be applied. In poison cases, rather than run the risk of perforation by the passing of tubes through the gullet for the purpose of gavage, rectal feedings should be employed for the time being, and in severe cases a gastrostomy may be required. In the slight forms but little treatment is necessary, and bland fluid or semifluid foods should be employed until the condition corrects itself, which is usually in a few days. About 0.03 gram of cocaine or 0.06 gram of eucaine in solution may be used to relieve the distress and induce more comfortable swallowing. The main indications are physiological rest of the esophagus and sedative measures. For the first two or three days the matter of feeding is not important. In severe cases a hypodermic dose of morphia may be called for to relieve the distress and nervousness. In a severe poisoning case by phenol which eventually died of nephritis, and in which the esophageal symptoms were intense for several days, I used, for feeding, the tube described for continuous drainage of the stomach, and which was passed after the patient swallowed some olive oil to lubricate the esophagus.

#### CHRONIC ESOPHAGITIS.

This type of esophagitis is most commonly seen in chronic alcoholics and as a result of repeated congestions brought on by disease of the heart or lungs. It is not uncommon to find more or less superficial change in the lower part of the gullet in cases of chronic gastritis or with excess of gastric secretions; this is particularly so when vomiting or regurgitation of food has been a long-standing feature. Recurring acute inflammations may bring on the chronic change, and the condition is

noted as a secondary change in esophageal cancer, ruptured diverticula, and dilatation of the tube.

Usually the condition appears as grayish streaks of degenerated epithelium on the summits of the longitudinal folds, with an increase of mucus in the tube. Occasionally, the color of the esophageal mucous membrane is a dusky red or bluish, and the membrane may have a granular appearance resembling that of a chronic granular pharyngitis. Superficial ulceration or rather desquamation in localized areas is often present, but must be searched for very diligently.

**Symptoms.**—These being very indefinite and usually masked by those of disease in other organs, the condition can only be suspected during life, and the diagnosis is usually made at autopsy. A history of a cause with some uneasiness or difficulty in swallowing and an indistinct sternal distress long persisting after the taking of irritating foods or drink make up the diagnostic points. Should distinct ulceration or stenosis result, the symptoms would more definitely point toward them.

**Treatment.**—The main indication in the treatment is the removal or improvement of the primary cause. Alcohol, pungent foods, tobacco, and hot fluids are to be avoided, and the taking of demulcent drinks and bland foods is advisable. In persistent cases topical applications to the esophageal mucosa may be employed. Of these, 1-per-cent. solutions of tannin or silver nitrate, applied (with the patient prone) by means of a small-calibred, long stiff catheter at short distances upward from the cardiac orifice, are of value. Bismuth suspended in olive oil may be given at intervals during the day, and the rather constant use of the well-known red gum lozenges helps to some extent.

#### ULCERS OF THE ESOPHAGUS.

More or less ulceration may occur with any of the conditions mentioned previously, but those forms are not included here. There are instances of esophageal ulcers which from the cause that enters into their production are classed as the decubitus, pressure, uremic, and peptic ulcers. The decubitus ulcers are found in emaciated persons who have suffered from exhausting disease (cachectic states, typhoid fever, and cancerous disease). They are usually shallow and situated at the beginning of the gullet at a level with the cricoid cartilage, and are most probably due to attrition of the apposed walls from emaciation of the protecting soft tissues and resulting pressure of the esophagus between the cartilages of the larynx and bodies of the vertebra when the patient is in the recumbent position. Pressure ulcers are those that occur from the pressure of encroaching growths situated outside

of the gullet, causing first a local anemia from compression and then sloughing of the dead tissue. Uremic ulcers occur in nephritis, in which condition ulceration in the colon may also be met with; the toxemia or possibly thrombosis noted in this condition seems to be the most plausible cause for their production. As a rule, the above types of ulcers give no definite symptoms.

Peptic ulcers are the more common of the four forms met with, occurring in about 0.13 per cent. of all autopsies. They occur at any age, are about twice as common in the male as in the female, and are usually situated in the lower part of the gullet and occur under conditions similar to those in which gastric and duodenal ulcers are found. The fact that this type of ulcer is also encountered in the stomach and the first part of the duodenum (what may be designated as the area limits of the gastric juice) causes me to believe that the gastric juice is directly responsible for its production. Therefore, in order that a peptic ulcer be formed in the esophagus it is evidently necessary that the cardia should be patulous, permitting of regurgitation of gastric juice into the esophagus, and no doubt a cardiospasm (secondary to an acute esophagitis from the long-standing irritation produced by the gastric juice) could cause retention of the stomach contents and resulting autodigestion of the devitalized mucosa at that point. This I believe is confirmed by the fact that in actual stenosis of the gullet or pylorus, or upward pressure of large abdominal tumors causing kinking of the esophagus, this distinct type of esophageal ulceration is liable to be met with. Alcoholism, arterial sclerosis, and trauma are also predisposing causes.

The simple ulcer of the esophagus resembles very closely both in gross and microscopic appearances the peptic ulcer of the stomach. It usually stops short at the cardia, although it may be found in the cardia and in the cardia area of the stomach. In the latter instance the ulcer probably began in the stomach and extended upward by continuity into the esophagus. In about four-fifths of the cases they are single; in the rest, multiple and very often are present with additional ulceration in the stomach and duodenum. In my opinion, they are as much a factor in the production of cancer of the cardia and gullet as is the same type of ulcer in the stomach and pylorus. About 15 per cent. of the cases perforate, which occurs into one or the other pleural cavity (usually the right) and occasionally into both. In other cases the aorta, pericardium or lesser omental cavity may be entered, or the process be confined to the periesophageal tissues and a pericarditis or pleurisy occur from carried infection. Healing frequently takes place with the production of a scar, which, if small in size and superficial, does no especial harm, but if of large size, deep and puckered, is liable to produce stenosis.

**Symptoms.**—In a large proportion of cases the ulcer was not suspected during life, being entirely latent or not giving rise to symptoms characteristic enough for a diagnosis. In another group it remains latent up to the time of perforation. The most important symptom of an open ulcer is pain in the region of the ensiform cartilage or beneath the sternum, radiating to the back between the scapulae. This is usually made worse by the act of swallowing or immediately afterward; in that way it is earlier in its appearance than gastric or duodenal ulcers. Dysphagia, probably produced by spasm, and hemorrhage are present in about one-half of the cases. The site of the bleeding may be learned by having the patient swallow about two feet of No. 15 braided surgeons' silk with a split shot fastened to the end, and (after tying the outer end to the ear, or securing it with a strip of plaster at the angle of the mouth) leave it in the esophagus for several hours; after this it is withdrawn, and the distance down from the mouth to the blood deposit will give the distance to the ulcer. In these instances the presence of blood may be noted in the stools. As a rule, vomiting is not present.

When perforation occurs the case quickly takes on a fatal aspect with sudden, intense, thoracic pain, dyspnea and collapse, and the physical signs of pneumothorax or hydrothorax. When the perforation is low and emptying below the diaphragm, a localized peritonitis in the lesser peritoneal cavity can occur, with the gradual onset of pain, dysphagia, and the symptoms common to perforating gastric ulcer. Such a rupture may occur spontaneously in a normal esophagus, but this is rare.

The prognosis in the average case is always most uncertain, with that of perforation and severe hemorrhage grave. The healed ulcer is very liable to develop a stenosis, and the possibility of remote malignant disease should be thought of. The occurrence of an esophageal ulceration as a complication of grave diseases seriously lessens the chances of recovery.

**Treatment.**—This is practically that indicated in a severe degree of acute esophagitis and gastric ulcer combined. No foods should be allowed by mouth and rectal feedings employed for the time being. In hemorrhage a few drops of adrenalin chloride solution by mouth (by means of a pipette) may be of service. The ergot preparations are of no value. If after a few days the case takes on a favorable aspect, it should be treated like that of gastric ulcer: by rest in bed, a fluid proteid diet (Leube cure), with bismuth, belladonna, and the external applications of cold or heat, whichever is the more useful in affording relief. Instruments should not be employed, the danger of perforation, hemorrhage, and infection by their use being too great. In a favorable

case after a few weeks the gentle and occasional use of esophageal bougies to prevent stenosis would be indicated. When recurrent hemorrhages are a feature, or atresia occurs, a gastrostomy should be performed as early as possible, accompanied by the string-cutting operation, and after this the tube kept open by the passing of dilating instruments (bougies) from the mouth. The cases of perforation are fatal, in which surgery, because of the inaccessibility of the gullet, up to this time has been of little help. Should, however, the symptoms be mostly of the abdominal order, the upper abdomen should be opened as early as possible, the perforation searched for, drainage established, and the operation finished with a gastrostomy.

#### STRICTURE OF THE ESOPHAGUS.

These may be divided into the non-malignant (cicatricial), malignant (cancer), and the spasms (esophageal, cardiospasm). The latter will be found described under the motor neuroses. The congenital stricture, usually found in the upper part of the gullet, is generally only mucous and submucous in nature, the other structures being normal in make-up and size.

The fibrous stenoses take their origin from inflammation or ulceration in which the loss of tissue is so great that in its repair an extent of scar-tissue formation occurs, the stiffness and contraction of which permanently narrow the lumen of the canal. The cause of the majority of the cases seen is the scar tissue resulting from ulceration due to the corrosive poisons; healed typhoid, the tuberculous or peptic ulcers; and gumma. The more concentrated the corrosive poison (usually a lye solution taken accidentally) the greater is the danger of a quickly developing stenosis. If only a few drops have been swallowed, or the solution was not a concentrated one, or a mildly caustic or irritating poison had been taken, there may be very little dysphagia, followed by a quick recovery with an apparently patent gullet; but finally a slow stenosis of greater or lesser degree may occur months later. For this reason one should always be guarded in giving a good prognosis until at least several months have elapsed and after the bougies have been passed. The sites where stricture is most likely to occur are at the natural narrowings where the corrosive or burning material is delayed, *i.e.*, at the level of cricoid, the tracheal bifurcation and the diaphragm. A stenosis, however, can take place at any other point, and when once established a moderate degree of dilatation is usually present above it. In the absence of any known cause for a cicatricial stenosis, and if the stenosis is in the lower two-thirds of the esophagus, syphilis should always be thought of as a probable cause.

**Symptoms.**—In the average case the first indication of the condition is a difficulty in swallowing not accompanied with any actual pain. This is noted more particularly when solid food had been ingested, and later on with the semisolid, and finally, in severe degrees of stenosis, with the fluids. The food that does not pass through is regurgitated after a variable time; when much dilatation is present above the stricture, this is usually somewhat delayed. The regurgitated foods are free from HCl and the stomach enzymes. As a rule, patients soon learn their swallowing capacity, choose such foods which in consistency easily pass the stenosis, and take all kinds of food very slowly and in small quantities at a time. When the food remains lodged in the gullet, a "sticking" or full sensation is referred to the top of the sternum. The second swallowing sound is commonly delayed beyond ten seconds, and may not be heard for nearly a minute; in other cases again so little fluid comes through the cardia that it trickles down the side walls of the stomach and the sound is absent, or may be rather indistinctly continued over a length of time. The swallowing sign of Revidtzev may be present. The diagnosis is usually confirmed by the obstruction offered to the passage of esophageal bougies (usually supplied with different sizes of olives and six in number) or a stomach-tube. In the use of the bougies, begin with the third olive and in successive trials proceed to the smaller or larger ones until the largest that passes has been noted. Since there is danger of perforation, only a slight degree of pressure to overcome the spasm and the irregularities that usually coexist should be exerted. Sometimes a bougie will pass one stricture only to meet with a smaller one lower down. When the smallest-sized olive cannot be passed, the hollow guide bougie passed on a string should be employed. In the absence of treatment, loss of weight from malnutrition is generally observed, and this, because of the mental anxiety attendant upon the dysphagia, may be seen in strictures even of a large caliber. In severe degrees of stricture an X-ray observation is most helpful; the negative should be made with the patient standing and immediately after swallowing the bismuth suspension, the plate being placed at the side.

The diagnosis rests between cicatricial stenosis for whatever cause and that due to malignant disease, polyps, outside the esophagus tumors, and spasm. Aneurism should always be thought of, and it must be remembered that foreign bodies may lodge in the esophagus for a long time. Esophagoscopy when carefully performed and under general anesthesia may be most helpful in the differential diagnosis. The prognosis depends upon the degree and extent of the strictured area, and whether regular dilatation is possible and feeding can be continued. Usually

the younger the patient and the earlier the treatment is begun, the better is the prognosis. For these reasons, also, poison and ulcer cases should be observed for some months after recovery.

**Treatment.**—In slight and sometimes in moderate cases the use of foods proper in consistency and regulated dilatation answer for the purpose of keeping the patients comfortable. The foods should be fluid or semifluid in character so that the element of retention is eliminated as much as possible. This usually means that less sacculation occurs above the stricture, less decomposition of foods in the gullet takes place, and thus the factors of spasm and subjective distress are lessened. The largest-sized olive or sound should be passed at regular intervals, first daily, then every second day, then twice a week, and following this as may be necessary to keep the stricture dilated; the taking of a tablespoonful of olive oil or glycerin before the dilatations is often helpful, first, by rendering this more expeditious and efficient, and, secondly, to minimize the danger of perforation. Rapid dilatation and rough handling of the sound or bougie are dangerous, and the sound should be left in for a few minutes at each treatment.

If it is apparent that such measures are unavailing, operation is indicated. This is also the case in the instances in which only a small sound can be passed or when evidences of malnutrition are developing. For a short time in passable strictures the use of esophageal galvanism may be employed. The next largest ball to that which passes should be used on the electrode, and with a plate below the patient (gluteal region), the current should be turned on and maintained for about five minutes. As high as 50 millampères of current should be used with the negative pole internally. This treatment was successful in one of the author's cases. In some cases in which malnutrition is well advanced, the strength of the patient can be improved for operation by gavage through a long catheter. When this cannot be accomplished the chances of an operation should be taken at once rather than resorting to rectal feedings for a long time. The string cutting operation (Abbe's), including a terminal gastrostomy and followed by regular daily dilatation, is the best operation; a gastrostomy should always be done, because in the failure of the method for enlarging the gullet a second operation would not be necessary, and if these succeed the repair of the gastrostomy channel is not a serious operative procedure. Another form of operation in a condition in which the passing of an instrument is impossible, is first to have the patient wash a string down by means of water. This having been accomplished by means of an ordinary drinking tube, a thread, and a glass of water, a temporary gastrostomy is performed, and the lower end of the thread

drawn out through the incision. A double linen fishline is then attached to the thread and drawn up through the esophagus into the mouth, and with one of these lines wire spindle bougies are drawn up, beginning with the smallest size, until a spindle is arrested. The wire is then made taut, thus putting the stricture in the stretch, and the other fishline is then pulled to and fro until the stricture is chafed through and the spindle allowed to pass into the mouth. The string should be left in place, and the procedure repeated at intervals until sufficient dilatation has been secured, after which the string is removed and the gastrostomy wound allowed to heal spontaneously. When the stenosis is marked, the performing of a gastrostomy for the purpose of permanent feeding is in order, an esophagostomy being not so easily performed and less rational. Various other methods of treatment have been devised. The use of strongly made rubber inflating bags covered with fine silk or cotton cloth and attached to the end of stiff tubes and inflated, and mechanical instruments having a set of jaws which are separated with a screw from above, have been employed in place of the gum-elastic bougie and the whalebone staff with ivory tip. Recovery has been reported by the use of specially devised cutting instruments manipulated through an esophagoscope. Lexer has recently reported a case of complete replacement of the esophagus in a young woman 27 years old, with a cicatrical stenosis of the esophagus, in whom a loop of the jejunum was first attached to the skin just beneath the mamma, forming a fistula through which she received food for several months. Then esophagotomy was performed, the esophagus united with the skin close to the fistula. Later the two openings were united and the surface over them closed, thus completing the restoration of the esophagus. The patient was then able to drink in a normal manner, but in eating solid substances she found it necessary to drink some fluid when swallowing in order to wash the larger pieces down. Thiosinamin (0.06 to 0.12 gram) has been used hypodermically every 2 or 3 days with apparent success for the purpose of softening the stricture so that the dilating instruments could be passed.

#### CARCINOMA OF THE ESOPHAGUS.

Cancer, the most important disease of the esophagus, may occur in any part of the tube causing stenosis with infiltration into the neighboring structures. Statistics from various sources as to the relative frequency of esophageal cancer and cancer of the other organs show these to be from 9 to 32 per cent. of all cases. The figures possible of being obtained in this country and Great Britain show cancer of the gullet to be only slightly lower than that of the stomach,

but those from Russia report the esophagus to be the seat of this disease in more than 32 per cent. of all carcinoma cases. It is probable, as McCrea suggests, that, in using autopsy figures, cancer of the breast and uterus, which are comparatively accessible and admit of surgical treatment, show a frequency of occurrence far below their real position, and thus those of esophageal cancer seem relatively high.

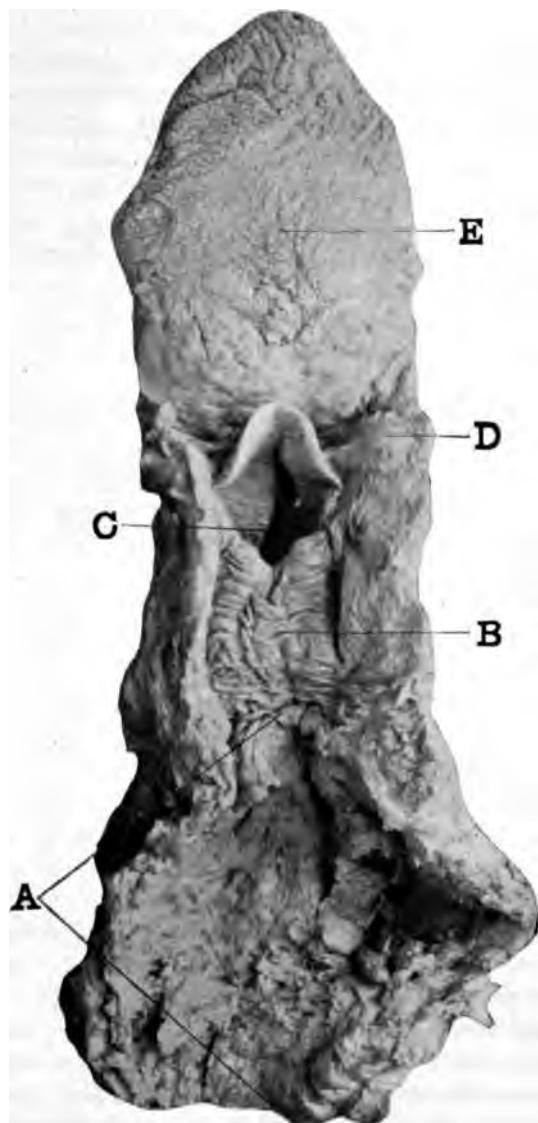
The disease is more often found in the male, and usually encountered between the ages of 40 and 60 years. Until the etiological factor producing cancer is known, its direct cause remains obscure, but it is most probable that among the important predisposing factors are ulcers more or less healed and which subsequently become irritated, traction diverticula, trauma from foods, and chronic esophagitis, particularly that form found in alcohol drinkers.

Most of the esophageal carcinomata are squamous-celled epitheliomata arising from the flat-celled mucosa that lines the tube, or adenocarcinomata taking their origin in the glands scattered throughout the viscera. Therefore most of the cases seen are undoubtedly primary in nature, and when extension into the gullet from the cardia or thyroid gland has occurred, the growth is usually of the same nature as the original neoplasm. In appearance with the tube laid open, the growth is usually about 8 millimeters in extent, encircles the tube, is shaggy in appearance, gray or yellowish-white in color, and rather soft in feel. In other instances such a growth may involve the tube in a more or less general way covering a greater area, or may be quite localized in the anterior wall. A soft, irregular, cauliflower-like mass with more or less ulceration and hemorrhagic areas is the less common form seen. When the growth is more or less localized a dilatation is usually observed in the canal above it. This is formed by the outward pressure of food lodging at the strictured point, without there having been sufficient time for an effectual hypertrophy of muscularis to take place to cope with it. In late cases perforation is very liable to occur with extension into the air passages, pleura, lung, pericardium, mediastinum, or blood-vessels. Extension of the growth into the surrounding tissues is the rule. The nearby large arteries and veins, the vagus and sympathetic, and the recurrent laryngeal nerve are generally found involved in the autopsy cases, and with left-sided extensions the thoracic duct and the brachial plexus are also included. The vertebrae may be eroded, and the large veins thrombosed. If the growth is low down near or at the cardia, extension into the peritoneum, diaphragm, and left pleural cavity and lung are usually seen. Metastases in the deep cervical glands are observed in the majority of instances.

**Symptoms.**—In a person over the age of 40, in whom there is no history of a cause such as might produce cicatricial stricture, who gradually develops *bona fide* difficulty in swallowing solid foods, and a stenosis exists, the odds are overwhelmingly great that its nature is carcinomatous. The beginning symptoms are usually those of stenosis described in connection with stricture of the esophagus. As the growth extends, however, a more marked degree of obstruction is observed, extending finally to inability to swallow fluids. Regurgitation is common and the higher in the gullet the growth is situated the sooner after ingestion it occurs, particularly if coughing is excited in the effort of swallowing. When the involvement is in the lower third of the tube a severe retching commonly precedes the regurgitation, and rather large quantities of alkaline food, more or less decomposed and showing no stomach secretions, are seen. The admixture of blood and pus is also noted when ulceration is present, and under these circumstances the breath is usually fetid. In a few cases dysphagia and regurgitation are not encountered; in others they are very little in evidence. This may be so even if the sounding of the caliber of the gullet by means of bougies and the clinical course of the case plainly suggest the condition. In one of my cases of the latter condition an extension into the base of the left lung (consolidation noted behind and irregularly running from the vertebral edge toward the axilla) was the first clue to the presence of the disease (in this instance the autopsy proved that the growth began at the cardia).

A constant feeling of pressure under the sternum with or without actual pain is common. Late in the case when the pains are severe they are usually lancinating, mostly nocturnal, and noted after the patient has been in a prone position for a while. They may be confined to the location of the growth or referred to the xiphoid region, or radiating behind and into the neck and shoulders. In these instances the pains are independent of the taking of foods. The cervical and supraclavicular glands when enlarged are palpable, especially those on the left side, and from extension of the malignant growth into the carotids, subclavians, intercostals, or their accompanying veins, a general carcinomatosis may occur, with metastatic deposits in the integument. With the involvement of the recurrent laryngeals there may be a very serious dyspnea, and a hoarse, brassy voice from paralysis of one vocal cord. The latter is the most constant early symptom next to difficulty in swallowing, and, in fact, cases are seen in which dysphagia is not a prominent feature and in which the examination of the larynx may give the first important clue to the condition; particularly is this so in left-sided growths. From pressure on the sympathetic, usually by

PLATE LVI.



Stenosing carcinoma of the esophagus. *A*, Upper and lower limits of the malignant growth, esophagus laid open. *B*, Uninvolved portion of the esophagus. *C*, Vault of the larynx, epiglottis above, arytenoid cartilages below. *D*, Tip of the hyoid bone. *E*, Dorsum of the tongue.



nodes, there may be contraction of the corresponding pupil, with ptosis, falling in of the bulbus oculi, and sluggish reaction to light (Hitzig). Distinct evidence of pressure upon the sympathetic is less often noted than pressure upon the recurrent laryngeals. From the difficulty of taking food and the ravages of the disease there is a rapid loss in weight and strength. Hunger is but rarely present, but constant thirst is common. Cachexia and severe anemia finally develop. The feces may give positive blood-tests. The duration of the disease varies from a few months to a year or two, death usually occurring from inanition, perforation, or hemorrhage.

As soon as the difficulty in swallowing has called attention to the possibility of stenosis of the esophagus, a local examination must be made. Bougies should be used to locate the site of the stenosis and measure its caliber, and if possible the area of stenosis. The first is easily accomplished by marking on the stem the distance down from the incisor teeth that the obstruction is met with, then using a stomach-tube and noting the distance down of the laryngo-pharyngeal junction (first obstruction to the tube after passing the posterior pharyngeal wall), and the difference in distance between the two represents the site of the obstruction below the beginning of the gullet. After this the stomach-tube is passed into the esophagus to the obstruction, an aspirating bulb is attached to its end by means of which a suction is exerted, and the tube quickly withdrawn. Such contents as are gained (usually only a small amount) are then examined for tissue particles, blood, pus, food, mucus and finally for HCl by the Günzburg reagent. Care must be taken in these examinations that too great a degree of force is not exerted, remembering always that the danger of hemorrhage and perforation is great. In all cases a radiograph showing the presence of stenosis, or in the less advanced cases an esophagoscopic observation, may be of the utmost value in the diagnosis. The latter really offers the only positive means of making an early diagnosis. By it the growth can actually be seen, its nature determined and the stenotic site accurately located. When carefully performed under general anesthesia there is less danger in its employment than the blind use of the other instruments, or by means of the special instruments devised for the purpose, and pieces of the tumor tissues for examination can readily be obtained.

The differential diagnosis rests between extra-esophageal growths which may cause a pressure stenosis of the gullet and possibly also paralysis of the recurrent laryngeal (aneurism of the arch of the aorta, mediastinal tumors, large tubercular glands in the mediastinum and laryngeal tuberculosis), and the various esophageal

conditions, particularly the benign stenoses due to the cicatrical deposits, cardiospasm, and foreign bodies lodged in the gullet. Sarcoma of the esophagus, an exceedingly rare disease, cannot be differentiated from the commoner neoplasm during life, save by microscopic examination of detached fragments. Its course and treatment are identical with those of carcinoma.

Early diagnosis of cancer of the esophagus can be made by means of the author's method of X-ray examination, or the Crump-Stewart method, described on page 146.

**Treatment.**—An early diagnosis made by first suspecting the possibility of cancer being the cause of the stenosis and then determining this by an examination through one of the endoscopic instruments used for the purpose, and the quick performing of surgical excision, offer the only possibility of cure. Because of the impossibility of complete excision of the growth by means of the esophagoscope, the chest cavity must be entered and the chances taken in doing a resection of a portion of the gullet followed by a gastrostomy. This is always a serious operation, but recent advance in chest surgery has now made it possible to reach the mediastinal tissues, and if the case seems to warrant the operation it should be advised. Torek recently reported a successfully operated-upon case. In the palliative treatment the first indication is to maintain nutrition, and when dysphagia exists the performing of a gastrostomy should be resorted to at the earliest moment; in this way the life of the patient may be prolonged and the subjective symptoms minimized in severity. This is particularly valuable in these cases, because the rule is that fatality in esophageal carcinoma when nutrition can be maintained is considerably retarded, some of the cases living two or three years. A fluid diet is advisable and the nutrition assisted by means of rectal feedings night and morning. Short tubes extending from below the strictured area to the back of the mouth and held in place by means of 2 strings which are fastened around the ears may be helpful in prolonging feeding by mouth. The use of such tubes is particularly helpful when perforation into the respiratory tract has taken place (suffocation and insufflation pneumonia from the food). Ten drops of a 2-per-cent. solution of cocaine, or about 20 of a 3-per-cent. solution of eucaine, taken just before the ingestion of foods, may relieve the distress incident to swallowing. If sacculation of the gullet above the stricture exists, lavage of the esophagus morning and night with a solution of bicarbonate of soda into which about 20 drops of tincture of nux vomica have been dissolved or a 1 to 1000 silver-nitrate solution may be helpful. A hypodermic injection of morphine before retiring for the night is often necessary to insure freedom from the

nocturnal pains and permit of sleeping. Where there is dysphagia with pain and general restlessness, I have obtained benefit from the occasional use of the following:—

R: Morphinæ vel codeinæ sulphatis ..... 4.0 3j  
Cocainæ hydrochloridi,  
Pulv. ipecacuanhæ ..... aa 3.0 gr. xlvi  
Fiat (pastels or lozenges) no c. Trochisci no. c.  
Sig.: Allow one to dissolve in the mouth about every three hours.

Recently a patient of mine claimed to have less pain and could swallow with less distress by the taking of small sips of olive oil, slightly salted, just before the foods and occasionally during the meal; subsequently meat powder was suspended in it with slight benefit to his nutrition. The external use of the X-rays has been employed without appreciable benefit. Einhorn reports benefit in the way of retarding the growth by the local use of radium.

#### NON-MALIGNANT GROWTHS OF THE ESOPHAGUS.

These are rarely met with, and when small in size are usually not suspected during life. The commonest is the fibrous polyp (fibroma) which may be pharyngeal in origin and as it grows hangs down into the esophagus (McCrea). The next in order of frequency are the proliferations of mucosa and submucosa (papilloma) which may exist anywhere in the course of the tube. Myomata, fibromyomata, and lipomata have been reported. Such growths may be single or multiple, are generally soft in character, and may be pedunculated or sessile. When large in size their presence gives symptoms of a constant stenosis of moderate degree in which the classical clinical signs of the other types of stenoses are absent. When situated in the gullet the esophagoscope offers the best means of diagnosis, and also, when pedunculated, permits their removal by means of a wire snare. The question of the advisability of removing smaller sized growths depends altogether upon whether or not they cause symptoms of obstruction.

#### INFECTIOUS GRANULOMATA OF THE ESOPHAGUS.

**Syphilis.**—Although exceedingly rare, syphilitic gumma in the submucous and muscular layers and shallow luetic ulcers of the mucosa may exist. Many authors deny that syphilis of the esophagus occurs, but there is no reason to sustain this belief. When one considers the structural make-up of the esophageal tissues it must be evident this organ can hardly escape involvement any more than the stomach or intestine could. Syphilis is a disease that can affect any organ or tissue in the human body, and most probably affects the

gullet oftener than is suspected. It is logical to assume that a gumma or the characteristic shallow and painless syphilitic ulcers that are seen as the manifestations of the disease in the gastro-enteron could exist without the giving of symptoms that would cause suspicion of their presence. Several years ago, at an autopsy on a middle-aged male subject who had had syphilis, I saw evidences of ulceration and maceration of the esophageal mucosa, with a much more severe ulceration in the colon, the stomach being exempt from any areas of thickening in the walls or ulceration of the mucosa. Recently I had under observation a man who gave the history of having a primary syphilitic lesion thirteen months previously and who, eight days before I saw him, suddenly developed difficulty and pain in swallowing. A moderate-sized bougie passed at the time showed the gullet to be patent throughout its entire course, but returned with a slight amount of blood and a few pus cells adhering to the shoulders of the olive. The introduction of the instrument having been easy, he was placed on mercurial inunctions and full-sized doses of potassium iodide, with complete cessation of the esophageal symptoms in six days' time. It is probable that some of the instances of apparent stenosis that have been successfully treated by antisyphilitic remedies were cases of irritative stenosis due to syphilitic gumma in the coats or ulcers in the interior of the gullet. The diagnosis can best be made by the Wassermann test, and the administration of specific remedies (therapeutic diagnosis), and it is advisable always to use these remedies for any case of esophageal disease in which a history of syphilis is obtainable or suggested.

**Tuberculosis.**—Tuberculous disease of the esophagus is rare, but may occur by direct extension of infection from the bronchial lymph-nodes or lungs, or by inoculation by means of swallowed tuberculous sputum. In general miliary tuberculosis deposits may be seen in the viscera. The involvement of the gullet usually occurs late in the course of the disease and when the reduction in general health is marked. For this reason and because definite symptoms referable to the gullet are masked or are absent, the diagnosis is rarely made during life. Perforation of a tuberculous ulcer into the pleura has occurred (Flexman, Stillman). Actinomycosis, blastomycosis, and trichiniasis of the esophagus have been reported. They also are very rare.

#### RUPTURE OF THE ESOPHAGUS.

In very rare instances spontaneous rupture of the esophagus may occur during severe internal pressure, such as retching or vomiting. It is very probable, under ordinary conditions, that with a large amount of fluid or food in the gullet coincident with strong diaphragmatic and

abdominal contraction that rupture could not take place unless there is present a weakened area in the viscus, such as may exist in congenital deficiency, degeneration, or inflammation of the muscular wall or mucosa (Brosch). However, several instances of rupture have been reported in which, at autopsy, the viscus was apparently healthy. The condition occurs in men, generally drinkers, in middle life. The tear usually takes place in the lower third of the esophagus or at the cardia.

**Symptoms.**—The symptoms are those of a severe effort at vomiting suddenly followed by intense pains in the chest or epigastrium, a choking sensation, dyspnea, cyanosis, and collapse. Most of the cases are rapidly fatal, death following in a few hours, although when the tear is small in extent this may be delayed until emphysema of the mediastinal tissues and root of the neck takes place. In the retching that usually follows blood and mucus may be brought up, further suggesting the condition.

**Treatment.**—This may be designated as expectant, a large-sized dose of morphine and the use of quick stimulants hypodermically administered being about all that could offer any service in the past. Still, if the diagnosis is made an early thoracotomy may save some of these patients. Of course, no foods or drink should be allowed by mouth.

#### DILATATION OF THE ESOPHAGUS.

Ectasia of the esophagus is generally due to the presence of stenosis interfering with the easy progress of food and causing sacculation of the tube above the stricture. Such dilatations are usually fusiform in shape, the widest diameter being just above the obstruction, which latter is most often found in the lower third of the gullet or at the cardia. Many so-called idiopathic cases have been reported in which stenosis did not seem to be present, although even in these it is reasonable to understand that an esophageal spasm or cardiospasm may have existed from local irritative or general neurological causes, permitting bulging of the canal above it, and which by the usual methods of examination would not be revealed. It is also possible that such examinations are often made during the intervening period of the spasm, or the tissues give way most readily to the dilating instruments, or would be relaxed and not disclose constriction when seen at autopsy.

In the absence of cardiospasm and other stenoses, these dilatations are generally considered as due to atonic degeneration of the wall. If it is reasonable to admit that in certain pathological conditions atony without stenosis permits of dilatation—and there is no doubt that this is true of the stomach and intestines—then it is also reason-

able to refer such cases in the esophagus to an unobserved, but still actual preceding chronic inflammation or ulceration, or to a muscular condition from malnutrition, which atony is great enough to allow stretching of the weakened fibers until they are unable to recover their normal tonicity.

Such a dilatation, then, could ensue without a preceding stenosis, and it usually is fusiform in shape, and most often found in the lower third of the esophagus. Most of the so-called idiopathic cases, however, have been described upon the most speculative etiology, of which the most interesting supposition is that of Fleiner, Strauss, and others, that these are explained by a congenital defect in the enteromeres, and that this is combined with a cardiospasm of neurogenic origin. More interesting in these cases is the fact that at autopsy such dilatations are usually fusiform in shape, and that when, during life, they had been examined by X-ray, it appeared as if a stenosis existed, but which actually was not present. In my opinion, Beneke's view of this is most logical—which is, that the traction and bulging of the lower part of the sac when it contains food pulls together the walls of the upper part of the undilated tube below, thus causing a kind of valve-like action at that point which further prevents the egress of the sac contents. And it is most probably due to this, that the majority of these cases clinically present themselves as those of esophageal stenosis, and in which the more or less constant distress is due to small retained particles of food decomposing in the gullet and thereby causing irritation.

**Symptoms.**—These are generally masked in those of stricture, remembering always that a strictured condition of the gullet can exist without a dilatation above it. The characteristic symptom is the regurgitation of rather large amounts of retained food more or less late after ingestion. While this food is in the dilated portion of the gullet there usually is a sense of oppression and weight and sometimes even actual pain in the sternal or epigastric region. At this time a degree of dyspnea is present with general restlessness and perhaps an increased flow of saliva. These symptoms generally abate when regurgitation has taken place and the gullet is emptied. If this is rather long delayed, the food becomes decomposed and the breath is foul. The food when returned early is about as it was swallowed, and when tested for the stomach secretions (HCl, pepsin) these will be found to be absent. When secondary inflammation has taken place in the sac more or less constant sternal distress is present. In stricture the passage of instruments will be obstructed, but in the so-called idiopathic cases this is not always so. The X-ray-bismuth

method of diagnosis may be most helpful in the diagnosis, although, as was mentioned before, could not serve to differentiate the true strictured from the non-strictured conditions. If the characteristic fusiform shadow is observed, the use of the bougie is the only way of distinguishing between the two types of dilatations. In the presence of constant sternal distress an esophagitis may be suspected. In these instances ulceration and perforation are liable to occur, giving symptoms of those conditions. In all cases more or less inanition, with constitutional symptoms, is present. Usually the history is chronic, being rather continuous over a few years. The second swallowing sound may not be present, or it may be late, and aspiration of the esophagus usually shows the presence of retained food.

**Treatment.**—In cases due to stricture the treatment of this dominates that of the secondary dilatation, and, in fact, in all cases it is wise to dilate the cardia thoroughly. To combat the effects of the decomposition of food also, some benefit can be derived from lavage of the gullet. For this purpose a recurrent tube should be used so that a large amount of retained water is not permitted further to distend the sac and also to obviate the filling of the gullet and flooding the pharynx. A tube should be employed which has the apertures of the inlet and outlet tube on a level near or at the tip. Plain water, normal saline, or boric acid solution serve a good purpose, and when inflammation has taken place a 5 to 1000 silver-nitrate solution is more beneficial.

In the idiopathic cases lavage should not be employed. About one-third of these cases are cured by the use of one of the various instruments for dilating the cardia. The instrument should be passed just into the cardia, the stretching performed in various directions, the treatment lasting for about 5 minutes at each *séance*. After six or more such stretchings the benefit usually becomes permanent, and the regurgitation stops, after which the patient usually makes most perfect recovery. In other cases the sounds or bougies answer. Electricity, mainly faradism, administered by means of an esophageal electrode with the positive pole in the gullet, answers a good purpose; the negative pole should be placed over the sternum, then the dorsal vertebra, then sat upon (gluteal region), and, lastly, on the neck. In one of my cases in a young woman I feel that beneficial results came from the use of the following:—

R <sup>o</sup> Strychninæ sulphatis .....	0.07 gr. j
Sodii bromidi .....	15.0 3iv
Elixir. adjuvantis .....	100.0 5iiiss

M. et sig.: Take one teaspoonful in a small amount of water three times a day.

The diet for a while should be semisolid in nature, including all of the foods, and these should be taken in small quantities every two hours or so. The rather frequent use of olive oil is grateful to these patients. Should the symptoms abate after dilatation of the cardia, regular food can be allowed. If not, operation should be considered.

#### NEUROSES OF THE ESOPHAGUS.

A local neurosis is present in every case of anatomical lesion of the gullet at some time. There is no doubt that neurotic conditions occur in the esophagus, although less frequently than in the stomach. It is usually quite impossible in a given case to conclude definitely whether the disturbance in the tube is an accompaniment to some local stimulating condition in its course calling forth the origin of the condition, or whether it is secondary to disturbances situated elsewhere in the digestive canal or neurological system. There is, however, in the majority of the acute cases a definite gastric condition combined with a neurasthenia or hysteria to account for them. In a continued severe case the most logical practice would be to explore the gullet carefully (possibly even with an esophagoscope), and take all matters pertaining to the general body into careful consideration with the hope of finding and removing an original cause if possible. For it is manifest that when, for instance, some local condition in the esophagus (inflammation, ulceration) or in the stomach (acute gastritis, neurosis) is present, the successful treatment for the functional esophageal condition depends principally on the care of the parent condition. The gullet not having a specific secreting function in so far as the digestive secretions are concerned, the neurotic disturbances of the gullet have been classed as the sensory and the motor.

#### SENSORY NEUROSES.

Hyperesthetic or paresthetic conditions of the esophagus are generally symptomatic of affections situated elsewhere. Anesthesia is said to occur after such infections as diphtheria, but I fail to understand, with swallowing naturally a sensationless function, how such a condition could be accurately diagnosed or even that it could exist. What has been termed hyperesthesia of the esophagus is the sensation of sternal distress that so commonly accompanies neurasthenic, irritative, and high secretory states of the stomach, and the conditions of disease in the tube itself. In these, such symptoms as a slight pain in swallowing, a tightening or weighty feeling in the chest, and a burning in the lower sternal region may be noted. The sensation of a lump,

ascending or descending, constitutes the well-known symptom of globus hystericus which is so characteristic of hysteria. The burning sensation (pyrosis) noted in states of high secretion, particularly when neurasthenic conditions also exist, is the one most often met with. In the production of this no doubt an insufficient cardia, permitting of regurgitation of irritating food, fluid, or gases from the stomach, has much to do with its causation. Pricking and sensations of roughness (paresthesia) are less commonly encountered and, in my opinion, are due to stomach or general neurological conditions. The diagnosis of a sensory neurosis of the esophagus as a primary condition should be made with reluctance, for usually in the presence of this condition diligent search will disclose the existence of organic, functional, or neurotic disorder in the stomach or intestine or some disorder in the neurological or circulatory systems accounting for its existence.

**Treatment.**—This requires that the cause be recognized and the disorder improved or removed by appropriate treatment directed to the condition that exists. Very often, however, the esophageal symptoms of distress are such a prominent feature that measures of relief are required to be instituted for a short time. In accomplishing this the bromides and the valerian preparations answer best. My experience has been that when marked esophageal distress exists, larger sized doses than ordinarily given are required to make the patient comfortable; thus, 1 to 3 grams of the bromide and 4 cubic centimeter doses of the tincture or ammoniated tincture of valerian may be called for. A prescription I recommend is the following:—

B Sodii bromidi .....	20.0	5v
Tincturæ valerianæ ammoniatae .....	25.0	f3vj
Aquæ chloroformi .....	q. s. ad	100.0 f5iiiss

M. et sig.: Take two teaspoonfuls in water at meals.

Because of the liability of the contraction of the habit, the opiates and narcotic drugs should not be employed, and attempts should be made to control the symptoms by the use of the safer medicaments in larger quantities. Neurasthenic states should be treated by nutritious feeding, hygienic, hydropathic and electrical measures, and by the employment of strychnine and the general tonics. The hematinic tonics are often indicated, and alkalies and atropine serve a good purpose in conditions of excess gastric juice secretion.

#### MOTOR NEUROSES.

As an entity these are more important than the sensory neuroses, and, excepting the few cases of merycism or rumination, are confined to

spasms in various parts of the canal. As a rule, they are more or less severe in degree and persistence. The spasm may be excited directly by local disease in the tube, or, as in most cases, by functional disturbance in the nervous system, particularly in those persons who may generally be classed as neurotic individuals. This latter combination is most often found in those who are rather continuously hysterical, excitable or restless in temperament. In other instances, again, the condition appears as a reflex from gastric disturbance, particularly in hypermotility, the acute irritative and the neurotic sensory gastric conditions. Pregnancy may be mentioned as a reflex cause. As was mentioned before, the spasm may occur in any part of the tube; it may be most general along all of its course, or rather local, especially when confined to the lower part of the esophagus in the region of the cardia. The spasm may be migratory, traveling to different locations in a short time; is usually constant in its duration, and the stenosis is never observable at autopsy.

**Symptoms.**—As a rule, the onset of the condition is sudden and not following any local cause for stenosis. In this it differs from all of the other esophageal conditions, and this point is most valuable in the diagnosis of the condition. All degrees of stenoses are encountered, sometimes slight and manifested only when certain foods are taken, at other times severe with complete dysphagia and regurgitation of material eaten some time before. In one who can swallow solid foods and not liquid, the condition should always be suspected; in these latter cases considerable pain in the retrosternal region may be complained of. Dyspnea, oppression, palpitation of the heart, anxiety, syncope, and even convulsions may accompany an acute attack. The patients are generally excessively agitated or exhausted during a seizure, which may last for only a few moments or even several hours. Instances are observed in which this variable history of acute attacks with intervals of entire relief have lasted over 10 or 20 years. In these neurological cases recurrence is particularly liable, and a long history of care in hospitals and under a number of different physicians is commonly obtained.

The cases I have seen have come under medical observation during the attack of spasm and the patients have given the history of some indiscretion in diet as the assigned cause. An interesting symptom in most of these was a rhythmical contraction of the faucial muscles, producing a clicking sound in the throat. There is often the history of more or less loss of weight, and evidences of malnutrition and loss of nervous control are apparent. A trembling of the limbs is noted, with alternate seizures of weeping and smiling in a meaningless way. A rapid pulse is generally detectable, the thyroid cartilages are prominent

from contraction of the pharyngeal and laryngeal muscles, and the neck muscles stand out prominently and are firm to the touch. The reflexes are exaggerated. If efforts of retching and vomiting are present, these are generally severe and persistent and the contraction of abdominal muscles most marked.

The diagnosis is usually made on the acute onset of the attack; the variability of the symptoms; the age, sex, and character of the patient, and the use of one of the esophageal instruments. In the passing of the bougie, sound, or stomach tube, the instrument is firmly grasped at the stricture area only to give way to complete patency of the canal in a few seconds. On the other hand, even in the acute attacks the instrument will pass without difficulty into the stomach, although usually more or less hesitancy is met with in the region of the cardia. A stenosis which quickly disappears after the short use of the dilating instruments, the emptying of the stomach, the use of anti-spasmatics, or galvanism is positively spastic in character.

**Treatment.**—The best treatment during an acute attack is the emptying of the stomach. For this purpose the employment of the stomach tube is not so efficacious as the use of emetics. The reason for this is that such attacks usually come on after a meal, and return through the tube is impracticable on account of occlusion of the tube with solid food. Apomorphine hydrochloride (5 milligrams or  $\frac{1}{12}$  grain) hypodermically administered produces prompt evacuation of the stomach, and is safer to administer than the irritating and less dependable emetics by mouth. This should be followed by enforced rest in bed, abstinence from foods for a day, and the rather generous use of bromides. The following suppositories may be used during the 24 hours, but not longer, to relieve the nervousness:—

R<sup>1</sup> Pulv. opii,  
Belladonnæ folii,  
Olei theobromatis ..... aa 0.4 gr. iv  
M. et fiat suppositoria rectalis no. vi.  
Sig.: Insert one high into the rectum every three or four hours.

It is obvious that, as in other neuroses, the main indication is to increase the tone of the general health and the nervous system so that attacks or spasms will not recur. For this purpose strychnine sulphate (2 milligrams,  $\frac{1}{30}$  grain) is of value and best given with valerian and the hematinic tonics. In the beginning of the treatment the addition of the bromides is often essential to minimize the danger of return, and belladonna or atropine may be employed as an anti-spasmodic. The use of the following is recommended:—

R. Bromoformi ..... 1.5 gr. xxij  
 Tincturæ belladonnaæ ..... 3.0 m. xlvi  
 Elixir. sodii bromidi (N. F.) ..... 100.0 g. iss  
 M. et sig.: Take a teaspoonful in water before meals.

Followed by and used singly later on:—

R. Strychninæ sulphatis ..... 0.07 gr. j  
 Zinci valeratis ..... 2.0 ss  
 Fiat cap. or pil. no. xxv. Sig.: Take one after meals.

Directions should be given that the stomach be never overloaded with food, and that the irritating articles of food as well as the use of tea, coffee, alcohol and tobacco be discontinued. Retiring early, the morning cold sponge bath, and other general hygienic measures should be advised, and in the end a sojourn in the country. When the case is severe or persistent, a gastric analysis should be made, the feces examined for parasites, and perhaps the esophagus examined directly. Errors of refraction should be corrected, diseased tonsils removed, and abnormal conditions in the ears corrected when found. An esophageal sound should be passed occasionally, and should obstruction be met with, firm, gentle pressure usually overcomes it, after which the instrument must be left in for some minutes. When cardiospasm exists, with or without dilatation of the esophagus, the regular employment of a dilating instrument often gives signal results. Successful results from suggestive treatment during hypnosis have been reported. In very severe cases the keeping up of the patient's nutrition is of prime importance. In such instances rectal feedings may be indicated, and even the performance of a gastrostomy for temporary use is on ~~very~~ rare occasions justifiable.

## CHAPTER XVIII.

### Organic Diseases of the Stomach.

#### ACUTE GASTRITIS.

SEPARATING the inflammatory diseases of the stomach of the catarrhal type into those which pathologically involve mostly the glandulature and are of short clinical duration, and those which involve also the submucosa, musculature, and connective tissue and are of longer duration, an arbitrary division into the acute and chronic forms is possible. While a division such as this is necessary to present the subject of inflammatory disease of the stomach, it must be said that sharp dividing lines between all of the types of these affections, both pathologically and clinically, must be very elastic. Even those types of involvement which are confined strictly to the epithelium and glandular parenchyma must be divided into the acute and chronic forms. The separation is further complicated by the fact that basically, in both the acute and chronic forms, a further division is necessary into the primary and secondary types of catarrhal disease. The close examination of the stomach walls in a case which may have presented itself as an acute condition will often show evidences of long-standing disorder. On the other hand, the stomach case which manifestly had run a chronic clinical course and which shows marked histological changes of a permanent nature, may also show much which is on the order of an acute condition. A greater or less degree of chronic gastritis is such a common and widespread condition that most stomachs when examined in section display not only the combination of the acute and chronic pictures, but even various parts of the same stomach will show marked differences in the elemental make-up. Approaching the subject of division from a pathological standpoint, uniformity of classification is almost impossible, although it would be the most desirable in the presentation of them. But approaching from the etiological and clinical standpoints, one can come nearer to some regular order.

#### ACUTE CATARRHAL GASTRITIS.

(Simple Gastritis, Acute Indigestion.)

Etiology.—Among the predisposing causes of acute catarrhal gastritis may be mentioned the acute fevers and infectious diseases; dis-

turbed states of the general system, such as gout and other metabolic disorders; low states of nutrition, such as debility, anemia and the blood dyscrasias; and states of chronic congestions of the stomach due to heart, liver, and kidney disease. The exciting cause is usually some dietetic error, consisting of overfeeding, eating when physically too tired to digest foods properly, or when mentally depressed with grief, sorrow, terror or anger; the taking of foods unsuitable for the individual, those which are unripe or improperly cooked, or tainted foods, such as ptomaine-bearing ice cream, fish and meats; overindulgence in alcoholic drinks, or a simple drink taken in large quantities and which is too hot or too cold; and the taking of irritating drugs, such as quinine, metallic salts, acids and alkalies, iodides, and salicylates. Trauma of the upper abdomen may precipitate an acute gastritis in rare instances.

The condition is more frequently met with in men, no doubt because dietetic error and overindulgence in alcohol are more common in that sex. It occurs in all ages from the infant to the very old, in the latter of whom it might be a fatal condition. Most of the cases are seen in the summer and fall, due probably to the eating of unripe or overripe fruit, the excessive drinking of ice water and alcoholic fluids, or the eating of food substances which had become tainted during the hot weather. Those seen in the colder weather are usually due to overindulgence at the table in food or drink, or both together.

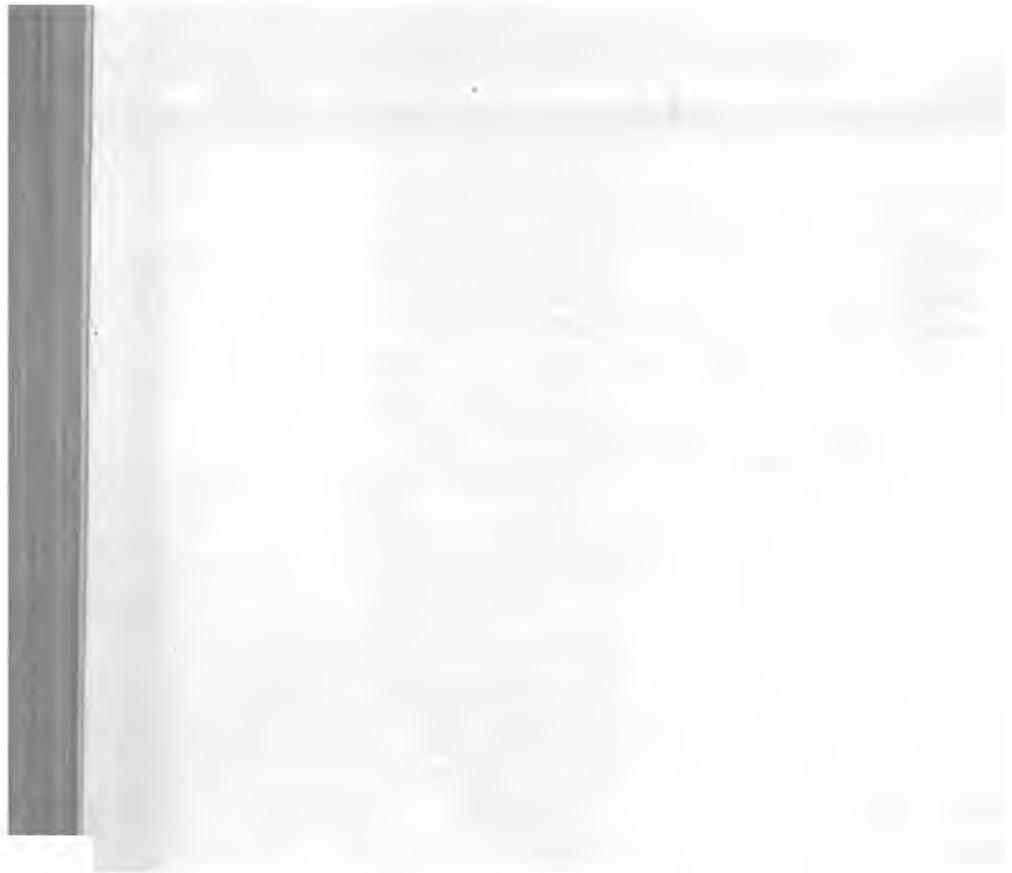
**Pathology.**—The mucous membrane of the stomach is swollen and presents a flat appearance. Congestion is usually present generally, although it may be seen in localized areas presenting a coarse mottling. Usually there is more or less tenacious mucus clinging firmly to the face of the glandulature. Spots of submucous hemorrhage may be observed, and small-sized superficial erosions are not uncommon in the pyloric region, which is usually the most affected in the process. The inflammation may extend into the duodenum, and in children may involve the entire length of the small intestine. Large suggillations may occur, but are rare.

The histological changes in the mucosa are usually marked, sometimes out of all proportion to the intensity of the symptoms. The gastric cells are swollen, and the interglandular substance may be injected with polynuclear leucocytes. Portions of the columnar epithelium may be absent. Many of the acid cells do not show nuclei, displaying merely a loose granular protoplasm. This same change is present in the central cells, but, because of their poor staining power, it is more difficult to observe this. The upper portions of the gland tubules may be missing, constituting small-sized erosions. Bacteria are

PLATE LVII.



**Severe acute gastritis.** The flat appearance of the glandulature is due to swelling caused by hyperemia, infiltration of the mucosa with round cells and polynuclear leucocytes, general cloudy swelling of the glandular cells and superficial epithelium, and the exudate in the submucosa. At numerous places over the surface of the organ are seen adherent masses of tough, cloudy-white mucus. The tunica propria of the entire stomach was involved, but below the submucosa the structures were not included in the inflammatory process. No pus or bacteria could be found.



commonly found, the more frequent types of which are the bacillus *aerogenes*, bacillus *coli communis*, proteus *vulgaris*, *oidium lobicans* and streptococci. Because gastric digestion is inhibited in these disorders, hydrochloric acid secretion absent and mucous production abundant, food particles adherent to the stomach surface are commonly met with. Beaumont has shown that the surface of the membrane during the attacks is usually alkaline, or but very faintly acid.

**Symptoms.**—The clinical aspect of these cases ranges all the way



Fig. 101.—Section through the glandular layer of the stomach of a case of acute gastritis, showing extensive round-cell infiltration in the interglandular structure. The dark spots represent hemorrhage.  $\times 105$ .

From the milder degrees of the simple dietetic forms in which the symptoms are mostly gastric, to those of the severe prostrating types due to ptomaine poisoning in which the symptoms are general as well as local in the stomach.

The onset is usually acute, following a manifest indiscretion in diet. There is first experienced a sensation of heaviness or fullness in the epigastrium, accompanied by a desire to belch. After ejection of some of the decomposition gases, a short spell of relief is obtained, which may be followed by gastric distress greater than before. Distinct nausea may be present, and, in those easily disposed to vomit, the stomach contents may be ejected, after which the relief of symptoms is

marked. In the milder cases, the gastric distress may run along for an hour or two, and then, without vomiting, it gradually subsides.

In the severe forms, nausea and acute gastric distress are early symptoms. Eruptions are rather frequent, affording only slight relief, and acute pains may be present in the stomach, radiating to the hypochondriac and sternal regions. There may be present severe headache, a moderate rise in temperature, anorexia, the regurgitation of small quantities of sour or bitter-tasting stomach contents, marked



Fig. 102.—Section through the stomach from a severe case of acute gastritis with exudate. The dark spots represent hemorrhage.  $\times 70$ .

thirst, palpitation of the heart, giddiness, rather continuous vomiting, and general nervous disturbance, such as restlessness and a feeling of fear with profuse sweating.

The vomited matter consists of undigested food mixed with mucus and bile, and is of an acid reaction due to the presence of organic acids. If the vomiting continues when the stomach contains no food, the fluid consists of saliva, mucus, bile, and even blood when the retching is severe. The ejected foods are usually seen in rather large-sized pieces, designating absence of digestion even after they had been retained for some hours. Together with the lactic and butyric acids found, acetic acid in those who have drunk alcohol may be present in easily recognized quantities. Hydrochloric acid is generally absent.

The abdomen appears bloated and the stomach markedly tympanitic and sensitive to pressure. The bowels are usually constipated, although diarrhea may follow the attack. The tongue is coated, and the taste pappy. Herpes, urticaria, or erythema may appear, especially when tainted fish and shellfish have caused the attack. As a rule, the urine is diminished in quantity and quite high colored, particularly in the febrile cases. An excess of indican is the rule when vomiting has not occurred and the bowels remain constipated. The temperature, present in about half of the cases, may run as high as 105° F. (40° C.), and may be preceded or accompanied with a chill or chilly sensations. The catarrhal inflammation may invade the duodenum, and, when obstructing the gall-duct, give rise to icterus, etc.

In the forms which ensue from the taking of poisoned foods—meat, fish, ice cream containing tyrotoxicon—the symptoms are those of a severe gastritis. The vomiting is incessant, and the prostration marked. Cases frequently occur in a number of individuals of a family at the same time, or in small-sized epidemics among those who have eaten of some particular food. In severe cases, the prostration symptoms of small, rapid pulse; feeble heart's action; cold, clammy skin; blanched countenance, and look of apathetic resignation may be pronounced.

Generally the attack runs from one to four days. Neglected cases or those occurring frequently in the same individual may, by gradual transition, develop into the subacute or chronic form. In the ptomaine-poison cases, where the prostration is marked, the patient is apt to die. The same may be said of acute gastritis which occurs in middle-aged and old persons late in the course of long-standing disease. A few cases in children also terminate fatally.

**Diagnosis.**—When a cause is apparent and acute gastric distress and fever are present, the diagnosis is easily made. The analysis of the vomitus showing absence or marked diminution of hydrochloric acid, the presence of organic acids, and the undigested character of the food is most significant. The slowly developing febrile forms in which the gastric symptoms are not marked may be confounded for a short time with beginning typhoid fever; the quick course of the one and the absence of the symptoms of enteric fever will usually clear the diagnosis.

While the Widal reaction would, of course, be absent in acute gastritis, the diazo-reaction of Ehrlich may be present, and thus much reliance should not be placed on its presence. It should be remembered that many of the infectious diseases begin with a history of acute gastritis. Thus it is that in all cases with high fever, when the cause is not plainly

apparent, we should be guarded until time for pathognomonic symptoms of other diseases has passed. The temperature in acute gastritis rises sharply and then falls uninterruptedly to a normal level. The presence of herpes labialis would speak in favor of acute gastritis, but it may also be present in malaria and acute pneumonia. Acute exacerbations of chronic disease of the gall-bladder and ducts and biliary calculi not causing much pain or any icterus may be mistaken for acute gastritis. The differentiation between these conditions is simple.

**Treatment.**—This may be divided into medical and prophylactic, the latter having to do with not partaking of those foods and drinks which would cause the condition.

**Medical.**—The stomach emptying itself by vomiting, or by diarrhea if the stomach contents have passed into the intestines, and the persistent anorexia show how admirably nature cares for these conditions. Along these same lines with treatment of any special symptoms, such as excessive pain, incessant vomiting, or marked prostration, the therapy should be laid. If spontaneous vomiting does not occur and the stomach is distended with gas and food, measures should be instituted for emptying it. This is important when the gastric distress continues marked or in the ptomaine-poisoning cases. Lavage of the stomach is the best means of accomplishing this. A hypodermic of apomorphine ( $\frac{1}{20}$  grain) may be given to promote vomiting in the sthenic cases, as it is always best not to give the strong emetics by mouth. In mild cases the drinking of one or two glassfuls of hot water may relieve the stomach distress, either by promoting vomiting or serving as an internal lavage in washing the stomach contents into the intestines. A little table salt or small amount of English mustard added to the water should be the only emetic measure employed per os. However, both Ewald and Boas recommended the following if emesis does not occur at the onset:—

B Pulv. ipecacuanhæ ..... 1.5 gr. xxij  
Antimonii et potassii tartratis ..... 0.05 gr.  $\frac{5}{6}$   
Fiat chart. no. j. Sig.: To be taken at once or in divided doses.

In children the syrup of ipecac may be employed in a teaspoonful dose. A better method, in my experience, is to use smaller doses of the syrup (say 20 drops), giving it every ten minutes until vomiting occurs.

After the emptying of the stomach foods should be withheld for some time.

Later on, fluids like strained barley, rice or albumin water, or weak tea may be employed. Solid foods should not be allowed until

the demand for them is rather insistent. On or about the third day thin soups, soft-boiled eggs, toast, bread and butter, oysters, and so on may be employed and, if these have been well borne, on the next day meats may be permitted, after which the resumption of the regular bill of fare would be safe.

When the local distress is marked, a mustard plaster on the epigastrium, immediately followed by an icebag, are measures of service. Turpentine fomentations to the abdomen are helpful when there is much general distention in the intestines such as is sometimes seen during the subacute stage. In all cases, it is wise to employ a purgative after the stomach has become tolerant. For this purpose calomel is best, because, in addition to its purgative action, it is the best intestinal antiseptic we have, and in some cases has quite a sedative action on the stomach. Because of these it has marked advantages over oleum ricini, which may even aggravate the stomach condition and re-establish the acute symptoms if given in the first forty-eight hours following the onset of the attack. The advice of Ewald of employing calomel in two large doses of 6 grains each, giving them one hour apart, is excellent and much to be preferred to the giving of small subdivided quantities. Citrate of magnesia and Seidlitz powder are too gaseous and bulky, and stronger salines are ungrateful to these tender stomachs. It is well to withhold all laxative measures until about thirty-six hours after the beginning of the attack.

In the treatment of special symptoms it may be said that internal antipyretics should not be employed. The pyrexia is of short duration, its presence is valuable to denote the course of the condition, and usually not high enough to deserve special attention. Furthermore, the less put into these stomachs the better, and should prostration suddenly occur one would not be pleased at having coal-tar products in the circulation at the time. For the pain and general distress a small dose of morphine or, better still, codeine administered hypodermically is helpful, but counter-irritation and hydropathic measures should first be tried before resorting to them. The following suppositories are useful:—

B Codeinæ sulphatis .....	0.30	gr. v
Extracti belladonnae .....	0.03	gr. ss
Olei theobromatis .....	q. s.	

M. et fiat suppositoria rectalis no. x.

Sig.: One every hour until relieved, after which they are to be discontinued.

If vomiting continues after the stomach has been emptied, the mechanical sedatives, bismuth salts or cerium oxalate, are of benefit. A prescription of value in this connection is the following:—

B Bismuthi subnitratis .....	6.0	ʒiss
Cerii oxalatis .....	2.0	ʒss
Sacchari .....	3.0	ʒj
Olei menthae piperitae .....	q. s.	

M. et fiat chart. no. x.

Sig.: Take one powder every hour until vomiting is controlled.

Sometimes a small quantity of brandy or cracked ice taken internally or a mustard plaster to the gastric region will control the vomiting sufficiently well. When the symptoms of hyperacidity are present, or pyrosis with thirst, the alkalies are of benefit. Lime-water on ice may be employed or the following :—

B Magnesii oxidι,		
Sodii bicarbonatis,		
Bismuthi subcarbonatis,		
Sacchari .....	āā	8.0 ʒj
Olei menthae piperitae .....	q. s.	

Fiat pulv. Sig.: Take one-half teaspoonful in water every three hours.

When the prostration is marked, sustaining measures should be employed. In cases of ptomaine poisoning resort to strychnia hypodermically may be necessary early. Of course, in these cases the stomach should first be cleansed by lavage so that further absorption of toxins is stopped, and an enema then given. Unfortunately if the case is seen somewhat late, the tainted food may have passed into the intestine, and as this could not be extracted, measures of quick purgation, such as croton oil or colonic enemata, may be wise after the lavage. The ptomaine cases not infrequently go into extreme collapse and require heroic treatment, such as would be employed in shock, to save them. Among these may be mentioned hypodermic injections of the stimulants strychnia, nitro-glycerin, ether, camphor, whisky, or the hypodermic preparations of digitalis. These may be used one quickly following the other without danger of overstimulation, for it must be remembered that in a serious case the prostration is progressive and liable to be quick.

Following an attack of acute gastritis, anorexia, aversion to foods, and some physical weakness may persist. In those cases the following tonic will prove useful :—

B Strychninæ sulphatis .....	0.05 gr.	%
Acidi hydrochlorici diluti .....	30.0	ʒj
Elixir. gentianæ (N. F.) .....	q. s. ad	120.0 ʒiv

Fiat mist. Sig.: Take one teaspoonful in one-half glass of water before meals, through a glass tube.

#### ACUTE SUPPURATIVE GASTRITIS.

(Phlegmonous Gastritis, Gastric Abscess.)

Acute suppurative gastritis may occur as a primary idiopathic malady or as a complication of other gastric affections. Among the

tter may be mentioned the forms which occur in stomach cancer or in the infectious diseases typhoid, puerperal fever, pyemia, variola, anthrax, severe exanthemata, and articular rheumatism. The disease as a primary affection is rare, and occurs either in the diffuse infiltrative or rather localized form of gastric abscess. Up to the present time, since Boerl first mentioned it in 1656, about one hundred cases have been reported. It is more common in men than in women, and is generally fatal. It is caused by the entrance into the submucosa of a virulent organism, usually the streptococcus, through some defect in the gastric

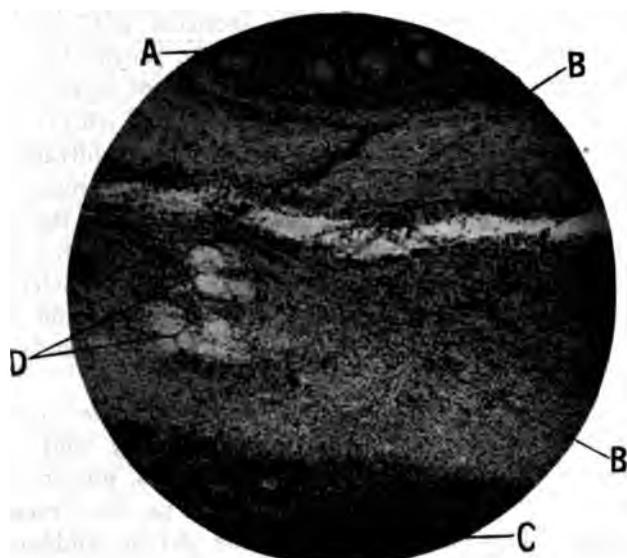


Fig. 103.—Photomicrograph of a section of the stomach of a case of phlegmonous gastritis. *A*, Gastric mucosa densely infiltrated with pus cells in the interglandular connective tissue. *B*, Submucosa very much thickened and infiltrated. *C*, Purulent collection which oozed out when the cut was made through the stomach wall. *D*, Fat tissue.  $\times 200$ .

mucosa, although at autopsy this defect is rarely seen. While the streptococcus pyogenes is the most often found, other organisms, such as the staphylococcus, the bacillus coli communis, and the pneumococcus, may be present. Where focal abscesses occur, mixed infection may be observed. It is usually met with in laborers of late middle life and of the alcoholic type.

**Pathology.**—The suppurative process may be rather general throughout the stomach, or be present in circumscribed abscesses in the gastric wall. In the diffuse inflammation, the pyloric region is mostly involved, presenting itself as swollen, boggy and pale yellow

in color. The esophagus is rarely attacked. On section of the pyloric submucosa, a glairy yellow layer from 1 to 5 millimeters thick, which on pressure exudes puriform material, is the common picture. In the diffuse forms, small shallow ulcerations down to the submucosa are often found along the lesser curvature and throughout the stomach. When these ulcers are very small (1 centimeter in diameter) they may display a granular floor with a reddened periphery. While the orifices of the tubules are usually clear, the papillæ of the duodenum may be prominent from increased stroma and polynuclear infiltration.

On microscopical examination the stomach wall shows marked infiltration of the upper layers with pus cells, polynuclear leucocytes, serum, fibrin, micrococci, endothelial cells, lymphocytes and eosinophilic leucocytes. The deeper layers are infiltrated with lymphoid and plasma cells and eosinophilic leucocytes. The infiltration usually extends throughout the interglandular tissue, causing small ulcerations on the surface, through which the pus wells up from the submucosa. The muscularis shows a fatty degeneration, and the peritoneum may be raised from it by inflammatory exudate. These latter cases are the ones which are liable to perforate, although the same may occur through a circumscribed abscess, which in size extends from the miliary form to one as large as a hen's egg.

Other accompanying pathological findings in these cases are congested areas in the region of the stomach, a cloudy fluid collected in the peritoneal cavity, congestion of the pancreas, pus in the pleural and pericardial sacs, pneumonia, nephritis, and purulent meningitis.

**Symptoms.**—The onset is acute. The patient suddenly experiences an intense pain in the gastric region which is not increased by pressure or change of position. With this burning pain comes an extreme thirst, dry tongue, and an obstinate fever of 103° F. to 105° F. (39.5° to 41° C.). The case may be ushered in by a chill. The pulse becomes small, fast and then irregular in the early stage. The patient is extremely restless and distressed, and these symptoms are soon followed by delirium. While retching is generally present, vomiting may or may not be. When it occurs, the vomiting consists mainly of mucus and bile, in which are pus-cells, numerous bacteria of the one type, and blood-cells. At the onset the bowels do not move, but shortly afterward a diarrhea occurs. Within a few hours prostration and coma ensue. Perforation into the general peritoneal cavity may occur, giving the abdominal symptoms of that condition, or the case runs a subacute course, continuing so for one or two weeks. Should abscess of any size occur, it might be felt externally. If a localized plastic

peritonitis takes place, a friction rub may be heard behind the costal cartilages on the left side (Wagner).

**Diagnosis.**—The all-important symptoms are the finding of pus and large amounts of bacteria (particularly streptococci) in the vomitus. As vomiting is the rule in these as well as in all cases of severe acute gastritis, this detail of examination should always be carried out. Should rupture of an abscess occur into the stomach it would be an easy matter to observe large amounts of pus in the gastric contents or vomitus. Its absence, however, should not exclude phlegmonous gastritis, because cases have been reported in which the stomach ejecta did not contain pus. One would then have to depend upon presence of organisms and the symptoms of pain, vomiting, meteorism, fever, diarrhea, and general phenomena of serious illness. According to Ewald, the cases may so mimic abscess of the spleen or left lobe of the liver that a differential diagnosis is impossible. When localized swelling is observed, an exploratory incision or puncture with an aspirating needle may be justified; the first is decidedly the safer procedure. In cases in which the physical signs are vague or the fever absent (small number of cases), diagnosis cannot be made during life.

**Treatment.**—As these cases are almost invariably fatal, especially the diffuse form, the treatment is only symptomatic. Among measures to be used is the lavaging of the stomach with a 1:10,000 corrosive sublimate or a half-ounce of boric acid to a quart of water. Large doses of opium can be employed to control the pain and general distress, ice-cold applications to the abdomen may be used, and when collapse occurs, the hypodermic employment of strychnine, ether, camphor, and like stimulating measures. Medicines by mouth are of little value, but iced champagne or brandy may be used with some benefit. Should localized abscesses occur, drainage by surgery is in order. Recovery has been reported, but remembering that all acute gastric inflammations, even the simple acute gastritis, are more or less infectious conditions, and that the diagnosis of the phlegmonous form is so rarely made and is such a fatal condition, mistakes in diagnosis may have occurred. Still, when only circumscribed abscesses are present, these, by rupturing through the mucosa into the cavity of the stomach, might drain sufficiently for spontaneous recovery to take place.

#### INFECTIOUS GASTRITIS.

What are designated as infectious gastritides are those conditions which are caused by the invasion of bacteria other than the strict suppurating type and those due to worms or fungi. Among causative

factors which have been reported are the diphtheria and anthrax bacilli, the favus, thrush and yeast fungi, and animal parasites, such as the larvæ of diptera (maggots). It is also known that ascarides and tape-worms reach the stomach in rare cases, causing inflammation.

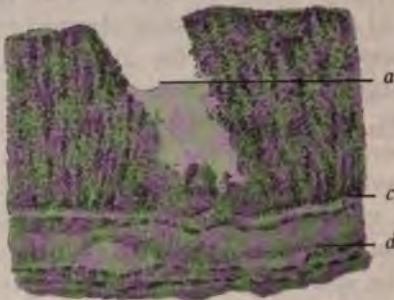


Fig. 104.—*a*, Erosion which affects the whole thickness of the glandular layer, and which stops on the confines of the muscularis mucosæ. The base of the erosion in the neerosed glandular tissue is in process of elimination. In the vicinity of the erosion the interglandular connective tissue has undergone slight embryonic infiltration. *c*, Intact muscularis mucosæ. *d*, Tunica muscularis. (*Dieulafoy*.)

Perhaps most numerous here are the pneumococcal infections, which occur not only in the lungs but may happen in the stomach, pleura, pericardium, peritoneum, etc. Such may occur as primary infections as well as secondary to pneumonia.

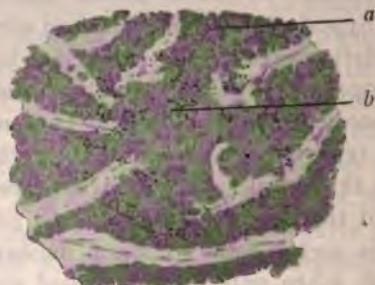


Fig. 105.—A tangential section of the mucosa on a level with the bottom of the erosion. *a*, The healthy glandular tissue, with a section of its tubes. *b*, The small glandular region, where the necrosis is taking place which will form the erosion. This is the earliest phase of the lesion. (*Dieulafoy*.)

The symptoms are those of a rather severe and prolonged form of acute simple gastritis, lasting with fever for one or two weeks, and may be mistaken for typhoid fever.

The treatment for them is chiefly expectant. With lavage and doses of calomel they are generally favorably influenced toward

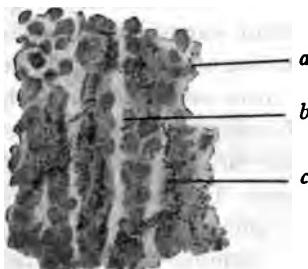


Fig. 106.—A section of the mucosa perpendicular to its surface, passing through an erosion. The preparation has been stained by thionine and Gram's method. *a*, The edge of the erosion. *b*, The glandular tubes. *c*, Pneumococci. The microbes infiltrate, not only the edge of the erosion but are found in numbers in the interglandular connective tissue at some distance from it. It might be called pneumocorrhagia—a name which appears the more acceptable as the capillaries of the mucous membrane are also infiltrated with pneumococci. (*Dieulafoy*.)

covery. Should there be reason to believe that intestinal worms are present in the stomach, measures for their removal should be instituted.

### TOXIC GASTRITIS.

**Etiology and Pathology.**—This is an intense form of gastritis produced by the ingestion of corrosive and irritant poisons. Among those taken by mistake or with suicidal intention are: carbolic acid, potassium cyanide, corrosive sublimate, arsenic, antimony, chloroform, alic acid, the mineral acids—sulphuric, hydrochloric and nitric—and the caustic alkalies in strong solutions. Strong solutions of alcohol and ammonia and croton oil should also be mentioned in this connection. When caused by the non-corrosive poisons, intense hyperemia and tumefaction leading to desquamative changes in the glandularis tissue. The mucosa becomes swollen, superficially necrotic, and hemorrhagic in spots. The corrosive substances cause a more general destruction of the mucous membrane, leading even to an involvement of the coats and rupture of the stomach into the peritoneal cavity. The non-corrosive group are less intense in the destruction of the parts they come in contact with, and are more commonly accompanied with degeneration of the mucosa and small-celled infiltration of the interglandular connective tissue. The lesions may be of various grades of severity, and are either general or localized. In the corrosive poison es the mucous membrane of the mouth, pharynx, and esophagus show necrotic areas.

**Symptoms.**—Shortly after taking the poison there is generally an intense agonizing pain with intolerable burning in the epigastric, sternal, and mouth regions. The stomach region becomes exquisitely tender, and pressure thereon causes marked distress. Vomiting soon ensues, which becomes incessant, and this, by increasing the pain, may cause fainting. The vomitus contains mucus, blood and, sometimes in the corrosive poisons, shreds of mucosa. The thirst is great, and a diarrhea, consisting of thin, bloody passages, is the rule when enough of the poison has been taken. Dysphagia is quite a common symptom. Severe general symptoms follow: small, very fast pulse, profound prostration, the skin cold and clammy, the respiration hurried, and delirium may be present. In cases where the poison reaches the general circulation, hematogenous jaundice, petechiae, albuminuria and hematuria may follow. Sometimes there is a marked febrile movement, the temperature reaching to 104° F. (40° C.), and life may be spared long enough for a fatal toxic nephritis to develop. Death may follow in a few hours, or in a few days from collapse, or later from perforation peritonitis. Much depends upon the character and quantity of the toxic agent swallowed and the quickness of the employment of antidotal measures of treatment. In the cases which recover from the acute poisoning stage, stenosis of the esophagus, cardia or pylorus may occur, or an atrophy of the mouth and stomach mucosa ensue, with subsequent inanition.

**Diagnosis.**—This, providing unconsciousness has not set in, is usually made by cross-examination of the patient, or by the history obtained from those near by. Added to this are the stomach symptoms and the information obtained from the examination of the mouth, throat, or vomitus. A chemical examination of the stomach contents and urine may be necessary. In the case of carbolic acid the smell of the breath is usually suspicious, while when "Paris green" had been taken examinations of the mouth will display vivid green-colored particles about the teeth and in the throat.

**Prognosis.**—This should be considered as serious in every case. Much depends upon the kind of poison and quantity swallowed and if vomiting had occurred shortly afterward. In these latter cases where free emesis had occurred, the local and constitutional effects are mitigated. Among unfavorable symptoms are early collapse and those of peritonitis. Favorable prognosis should be withheld until the time for severe secondary effects has passed.

**Treatment.**—To ascertain first the poison taken and the use of an antidote for that substance are measures of prime importance. If the case is seen early, the stomach should be washed with warm water

PLATE LVIII.



Stomach from a case of toxic gastritis due to carbolic acid poisoning. The entire inside of the stomach showed the caustic effects of the poison. The glandulature was thickened and firm, and had an opaque milky appearance. There were small hemorrhagic spots here and there, and in places the submucosa had been bared of mucosa. The stem of the specimen is the esophagus.



containing some demulcent substance and a small quantity of the antidote. Lavage, however, should not be resorted to when some time has elapsed after the ingestion of the poison, for if deep necrosis in the stomach exists there is danger of perforating that organ. Syphonage of the stomach would then be preferable, and for this, even in extreme cases, it is always best to employ the tube and take chances. The employment of a soft stomach tube is safer and more satisfactory than the use of the Kussmaul pump.

Among the antidotes employed are: in the caustic alkalies, dilute vegetable acids, lemon and lime juice, or vinegar; in antimony, tannin in demulcent drinks; in arsenic, sesquioxide of iron, made by adding carbonate of sodium to tincture of the perchloride, or dialyzed iron may be used; in carbolic acid, alcohol, solution of sulphate of magnesia or of soda, dilute sulphuric acid, or saccharated solution of lime; in hydrocyanic acid, 2 drams of magnesia in water, followed by 15 minims of perchloride of iron and 12 grains of ferrous sulphate in aqueous solution; in iodine, starch water; in mercurial salts, white of egg and flour; in oxalic acid, lime or magnesia; in phosphorus, sulphate of magnesia. The use of olive oil or molten vaselin in the stomach, after neutralization and lavage, diminishes the effect of the corrosive poisons excepting in phosphorus poisoning.

Additional matters of treatment are the use of morphine to control the pain and general distress, bismuth and bits of ice to allay the irritation, and an icebag externally in peritonitis. Nutrition should be maintained by rectal enemata only, and recourse to stomach feedings should not be permitted until recovery is well established. The other points of treatment are entirely symptomatic. Prostration and collapse should be combated by the usual measures of quick stimulation.

#### HEMORRHAGIC GASTRITIS.

Hemorrhagic gastritis is generally due to disease elsewhere in the body than in the stomach and from which the stomach, probably for toxic reasons, becomes markedly affected in a congested way and takes on hemorrhagic proclivities attended with the occurrence of blood in the stomach and perhaps the vomiting of considerable amounts of blood. The best description of this condition was originally given by Dieulafoy<sup>1</sup> in connection with toxic effects from chronic disease of the appendix. Dieulafoy described it as appendicular vomito negro. This condition he described in a lecture to the Academy of Medicine in Paris in 1903. It is supposed to be due to toxins from bacteria which develop a high degree of virulence in the appendix by being locked up and the resorption of

these toxins into the general circulation which in some way affects the glandularis of the stomach probably by a process of excretion into it. The bleeding is supposed to be due to ulceration of the arterioles ramifying under the muscularis mucosa. While it is rare, the condition may also come on in a few instances of gall-bladder pathology and toxic conditions of the large intestine, mainly those associated with ulceration due to organisms of the *B. coli*-dysentery-typhoid grouping.

At operation in such cases a distinct thickening of the stomach wall in the vicinity of the pylorus is noted (pyloric blush) and less so in the submucous structures. On opening these stomachs, there is found a marked congested condition of the pyloric region. Here and there, there may be areas of small hemorrhage into the mucosa. I have seen nine instances in which these have bled with the production of alarming states of hematemesis. Cure of the condition being brought about by the removal of the appendix. Five instances were due to bacterial effect from ulcerative conditions of the large intestine in dysentery of the bacillary types.

**Treatment.**—The condition is grave unless the cause supplying the toxins which affect the glandularis of the stomach is removed. It is found usually in the appendix, although, as stated above, other organs in the abdomen may be the source of the focal infection. In addition to this, at the time of the hemorrhage the treatment consists of absolute rest for the stomach, no liquids by the mouth, large injections of serum and treatment for hemorrhage in a general way, etc.

The author wishes to re-emphasize that in instances where there is alarming hemorrhage from the stomach without an ascribable cause, hemorrhagic gastritis from toxic causes appendicular in origin should be thought of as a possible explanation.

#### REFERENCE.

<sup>1</sup> DIEULAFAY, Textbook of Medicine, vol. i, p. 662.

## CHAPTER XIX.

### Organic Diseases of the Stomach.

(Continued.)

#### CHRONIC GASTRITIS.

##### PRELIMINARY REMARKS.

WHAT is designated as chronic gastritis is a clinical entity due to pathological changes in the stomach, and not necessarily any gastric case which simply runs a chronic or subacute dyspeptic history. The term "catarrh of the stomach" is as unfortunate in this connection as is "catarrh" of any other part of the human economy. The author fully coincides with Ewald and Penzoldt in objecting to this obsolete term, which, like "malaria" and "congestion of the liver" of the past, covers a condition of ignorance, and thus is doomed to oblivion in the years to come. For, to be literal, the definition of the term catarrh means a discharge of fluid from a mucous membrane, and this, like edema, cough, etc., deals with a symptom and not with the causative pathological condition. More than this, even in the light of symptomatic worth, severe as well as slight degrees of organic stomach change may exist without any increase in the amount of mucous flow beyond the normal quantity. Likewise, it must be said that the term "chronic dyspepsia" (sometimes used as a synonym for chronic gastritis) also should not be used. The reason for this is because chronic dyspepsia deals only with the length of the clinical course and not with the pathological or clinical diagnosis, which, it may be said, is as liable to be a simon-pure neurotic disturbance of secretion, motility, or sensation as it is one due to degeneration and desquamation of the glandular cells, infiltration of the connective tissue, or organic change in the musculature of the stomach.

A clinical and therapeutic distinction of service in severe cases of chronic gastritis is the division of the cases into one of two types—the sthenic and asthenic. The sthenic cases are those which have to do with increased secretion of hydrochloric acid and gastric enzymes, and sometimes motility; and the asthenic those in which these are diminished or absent altogether. In the pathological classification three main types of chronic gastritis may be separated, namely, the simple chronic gastritis in which the elements in the glandulature mostly are

affected; the hypertrophic or sclerosing form, where in addition to the above the connective tissue and musculature are proliferated; and the atrophic form showing loss of epithelium, actual destruction of the glands, and more or less growth of connective tissue in some cases.

Added to these distinctions again are the primary and secondary types. The former are the cases which develop and are sustained by continued indulgence in foods unsuitable in quantity or quality, the overindulgence in alcoholic drinks, or the use of irritating alimentary substances, among which may be mentioned tobacco, abuse of purgatives, etc. The secondary forms are those which develop from attacks of acute gastritis plus continued indiscretion, and those which represent complications of other gastric or general affections.

Chronic gastritis is clinically a disease of degree of pathological change rather than one of definite type of morbid process. For while knowledge of definite states of morbid process at the time present much of practical value, it must never be forgotten that in these conditions one state of pathological process is a transitory condition passing from the beginning one in the superficial structures to the end ones in which all of the layers of the stomach are more or less involved. Nor does the whole of any one or all of the layers of the stomach affected always display a uniform degree of change. Within one microscopic field the mucosa of what may be considered as a simple chronic gastritis may show distinct infiltrative change on the one hand, as well as perfectly normal tubules on the other, and in what may be considered as a distinctly hypertrophic condition may display normal, simply affected, or atrophically involved tubules and submucous or muscular involvements, and even in the atrophic conditions normal tubules may be seen alongside of tubule sheaths completely devoid of cells, while the interglandular and submucous tissues may display normal areas as well as some markedly infiltrated. It is for these reasons that it is proper to keep in mind a rather composite picture of the various pathological states, and view them all in the migratory sense of one as parent to the other, with simple chronic gastritis as the beginning and complete atrophic change as the end destructive condition. It is most probable that it will always remain impossible in the living subject to diagnose just what the detail picture of the stomach layers in a chronic gastritis is. Gastric analysis, states of motility, lengths of history, and subjective symptoms are all we now have to figure upon, and with these in our present state of knowledge, and unless we accidentally gain particles of gastric mucosa for examination, much of the diagnosis in the ordinary run of cases remains as a supposition, and thus the most logical basis of treatment remains fixed upon rather symptomatic standards.

**ETIOLOGY.**

Chronic gastritis is a common and widespread disease, occurring in all stations and ages of life, and more frequently met with in men than in women. It is caused in the direct cases by continued dietetic errors and methods of eating, among which can be mentioned the eating of foods inferior in quality or improperly prepared, rapid eating (resulting in imperfect mastication), overfeeding, excessive drinking of iced fluids, and the intemperate use of alcohol. The excessive use of tea, coffee, and tobacco are additional potent factors, and so is overindulgence in carbohydrates and fats. Among many cases it must be said that two or more causes are usually existent in the same case, and that all of the factors given tend to irritate the stomach and therefore cause a change in the condition and function of the organ.

Rapid eating and overeating, the continued taking of overseasoned foods, and the drinking of alcoholic or iced drinks are the most common causes in its production. Among those who habitually partake of the lighter forms of still wines at their meals, chronic gastritis is not so common as in those who partake of the spirituous ones (whisky or liquors), those which are carbonated (champagne, sparkling Moselle), or those which contain much carbohydrate (beer, ale). The etiology in moderate alcohol drinkers is often associated with dietetic error, and these cases are liable to be found in those who are well nourished and who lead a steady and regular life in other ways. Among direct conditions which may start a chronic gastritis may be mentioned an acute gastritis incompletely resolved, typhoid fever, and an unhealthy condition about the mouth, such as carious teeth.

Chronic gastritis is commonly present as a secondary disorder caused by the irritation of other gastric affections. Among these are cancer, ulcer, atony, and long-standing neurotic secretory and motor disturbances. It also accompanies the constitutional disorders of anemia, chlorosis, leukemia, chronic tuberculosis, Addison's and Bright's disease, gout, nephritis, diabetes, syphilis and amyloid disease. And, again, it may result from conditions of the portal circulation causing chronic engorgement of the digestive mucous membrane, such as is present in hepatic cirrhosis, chronic heart and some chronic lung affections, and Banti's disease. It may accompany or develop from almost any subacute or chronic disorder causing debility or devitalization of the general tissues of the body.

**PATHOLOGY.**

**Simple Chronic Gastritis.**—In simple chronic gastritis the organ is usually slightly enlarged, the mucous membrane pale gray and in

parts reddish in color, and covered with a closely adherent, tenacious mucus. At the pyloric end, the mucosa may be found irregularly pigmented and presenting a rough, mammillated surface; to this latter condition has been given the terms *état mammeloné* and *gastritis polyposa*. While the membrane is usually thicker than normal, it may be much thinner and firmer. The pyloric region is most affected although a very general uniform process throughout the organ may be observed.

The minute anatomy shows a parenchymatous and interstitial inflammation of the glandularis, and in long-standing cases limited states of infiltration of the submucosa and perhaps some degree of hypertrophy or atrophy of the muscularis. The gland cells show cloudy granular swelling, and the distinction between the central and acid cells cannot be recognized, particularly in the glands of the pyloric region. Usually with tubules giving the above-mentioned picture are seen tubules containing cells in more or less advanced states of fatty degeneration, cells detached from the basement membrane and lying free in the space, or tubule sheaths entirely devoid of cells. The common picture of the cells is one of mucoid degeneration. It is this rather composite degenerative state of affairs in the glandularis that gives in the histological examination of all types of chronic gastritis their similarity. The difference plainly is only one of degree, although in what may be considered as the true simple chronic gastritis only the cells in the upper part of the tubules may be affected, while those near the fundus of the gland may be found quite normal. The tubuli themselves may have lost their normal regular arrangement and show atypical branching like the fingers of a glove. This spreading is due to round-cell infiltration, which is seen mostly in the superficial region of the glands. The gastric epithelium is frequently defective, and the mouths of the glands are filled with a pale mucus. The veins are usually enlarged, and small areas of hemorrhage may be observed in the pyloric region.

**Hypertrophic and Sclerosing Gastritis.**—These types represent more advanced conditions than the above. The membrane may either preserve a rather normal appearance or is most irregular from hypertrophic changes in the connective tissue about and below the glands, causing the mucosa to be thrown up in ridges. The histological state which causes the formation of these ridges is particularly connective-tissue change about the ductus alveoli of the peptic glands. If these hyperplastic processes are confined to localized areas they cause irregularity on the surface of the membrane at that point, while an inch or two from it the membrane may have quite a normal appearance.

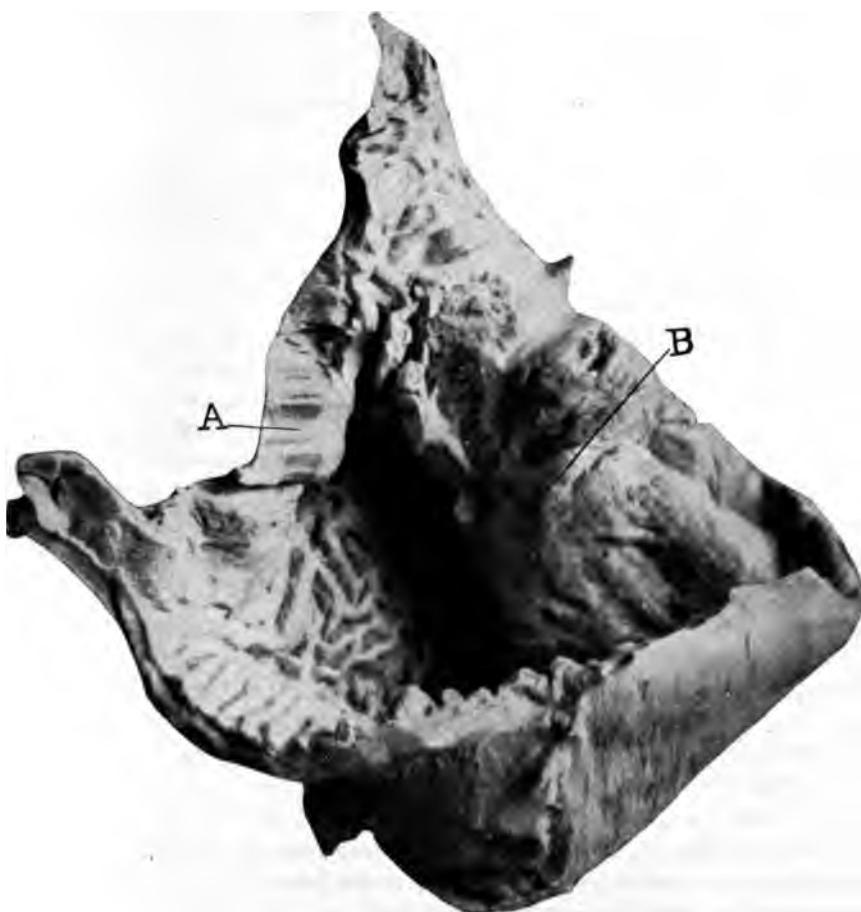
PLATE LIX.



Gastric mucosa in a case of advanced hypertrophic gastritis due to chronic alcoholism. In places the membrane was hemorrhagic but it had mostly a dull slate gray color. The mucosa was much thickened and thrown into ridges. All of the coats were hypertrophied. The organ contained much fairly firm, thick, glassy adherent mucus, and sections through the organ showed all stages of degeneration of the glandular cells; increased fibrous tissue formation, mostly between the vestibular entrances to the gland ducts—the contraction of this fibrous tissue is the cause of the ridges—and of the musculature, mostly at the pylorus. The stomach as a whole was not contracted and there was no actual stenosis (hypertrophic) at the pylorus.



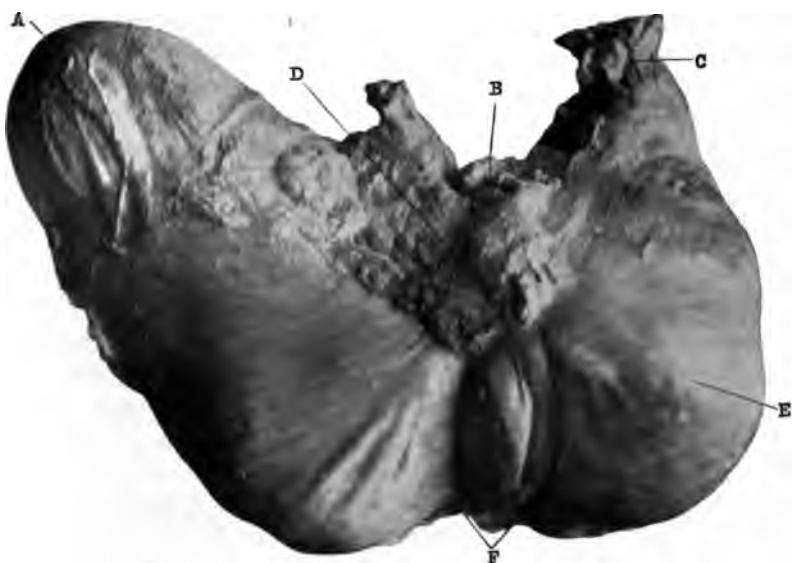
PLATE LX.



Hypertrophic gastritis. *A*, Pyloric region laid open showing the thickened musculature and increased fibrous tissue. *B*, Cavity of the stomach. The mucous membrane is thrown up into the rounded ridges seen in a late hypertrophic gastritis. The tubules in the glandularis itself had been practically destroyed (atrophic gastritis). The entire organ was contracted and stiff from connective tissue formation in all of the layers.



PLATE LXI.



Posterior view of the stomach of advanced gastric cirrhosis due to a sclerosing gastritis. In some parts of this specimen, at *E*, the stomach wall was 2 centimeters in thickness and was a firm fibrous consistency with marked hypertrophy of the musculature. The pyloric aperture was 0.5 centimeter in diameter and the distance between the center of the cardia and the pyloric opening was only 4 centimeters. Below the attachment of the gastrophrenic ligament, or lesser omentum, is seen a constriction running vertically through the organ, giving the appearance of a typical hour-glass contraction. The cavity of the stomach held only 265 cubic centimeters of water. *A*, Fundus. *B*, Cardia. *C*, Pylorus. *D*, Attachment of the gastrophrenic ligament. *E*, Thickest parts of the organ. *F*, Constriction partially dividing the lumen of the organ. (The reproduction is a trifle more than two-thirds the actual size of the organ.)



PLATE LXII.



Gastric mucosa from a case of atrophic gastritis due to chronic alcoholism. From the cardiac end, along the lesser curvature to the pylorus, and almost all of the left half of the specimen, shows a flat appearance to the mucosa. The lower right quarter shows evidences of a hyperplastic gastritis (marked rounded ridges). In the entire specimen the glandulature had been destroyed and replaced by fibrous tissue and small round cell infiltration. There were no secretions of hydrochloric acid or enzyme in this stomach during life.



When the submucosa is involved, as is generally the case, the loose tissue of this strata is rendered tougher and more inelastic, resulting in less freedom of movement of the glandularis upon the inner muscular coat.

This fact, interfering as it does with the proper degree of circulation of blood to the glandularis during digestion, together with the destruction of the cellular elements in the tubuli above, which ranges from simple protoplasmic change to complete loss and vacuolization, explains the absence or decrease of secretion of gastric juice in these cases.

In the further advanced conditions, a sclerotic atrophy, with thinning of all of the coats of the stomach (phthisis ventriculi, or complete atrophic gastritis), may ensue, or an enormous thickening of the coats of the stomach may be found, due to an hypertrophied muscularis from chronic inflammation transmitted down from the submucosa (cirrhosis ventriculi).

When this is present the general infiltration and contraction of the connective tissue and the hypertrophy of the muscular layers cause marked reduction in the size of the organ. There being more muscular tissue in the pyloric region, a stenosis of this area is often observed, and to which condition the term hyperplastic stenosis, in contradistinction to the stenosis of malignant disease, has been given. The hypertrophic muscular types of late gastritis are, in my experience, less common than the atrophic form, in which the organ remains normal in size or is somewhat dilated.

**Atrophic Gastritis.**—This form may be the termination of a simple chronic gastritis or it may begin as an atrophic form at the start. It represents the end pathology of the most severe types of chronic gastritis, one, it may be said, in which the stomach as an organ had lost its function of secretion (other than mucus), but usually retains the faculty of sensation and some degree of motility. It is probable that the typically thinned-out stomach of an atrophic gastritis begins as a glandular involvement in which early deep submucous and muscular change is not so much of a feature as those which pass to the hypertrophic stage from a simple chronic gastritis. I believe that the extent of inflammatory cell infiltration of the stomach layers is the determining factor in producing a progressive chronic gastritis in one case in an hypertrophic state and in another an atrophic state. It has appeared to me, from careful microscopic examination of the stomach walls in three cases of atrophic gastritis, that the condition was due to a gastritis more definitely confined to the glandulature, and in which there was a more complete degenerative change in the tubule cells as an early result. The pathological picture

in these stomachs is one of extensive change in the elements of the tubules, and, from lack of gastric function, an atrophy of the organ takes place such as invariably occurs in the soft parts of the human body from loss of specific function.

The surface of the mucosa is smooth and of a grayish color in complete cases. General pigmentation and congestion are not often seen, but areas of hypertrophic formations, hemorrhage, or small

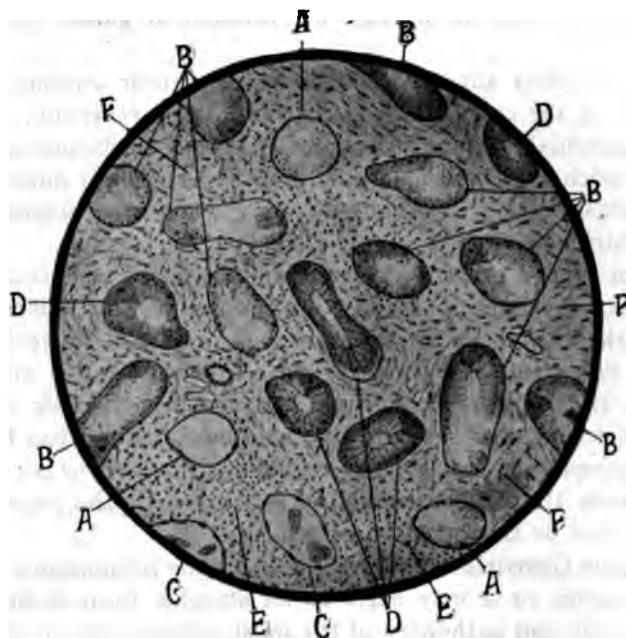


Fig. 107.—Mucosa in atrophic gastritis. Microscopic view of a post-mortem section from an alcoholic case of long standing. *A*, Round spaces of tubules denuded of cells. *B*, Gastric tubules containing cells with mucoid degeneration showing loss of cell-structure and staining power. *C*, Gastric tubules showing the intermediate stage between *A* and *B*. *D*, Apparently normal gastric tubules. *E*, Small round-cell infiltration. *F*, Increased interstitial tissue.  $\times 400$ .

ulcerations may be observed; the latter are termed chronic catarrhal ulcers.

The study of the glandulature shows marked degeneration and destruction of the glandular elements. While in a case not completely advanced, tubules may be seen containing cells which stain well and are in proper alignment, the majority of them are in a greater or less stage of degeneration. These are noted in the processes of mucoid and fatty degeneration, the detachment of the cells from the

basement membrane, and finally their complete disappearance, leaving only empty spaces. In the advanced cases the infiltrative and contracted changes of the interglandular substance finally close up the tubules, causing their obliteration and leaving here and there irregular, cyst-like formations. An occasional tubule down near the submucosa

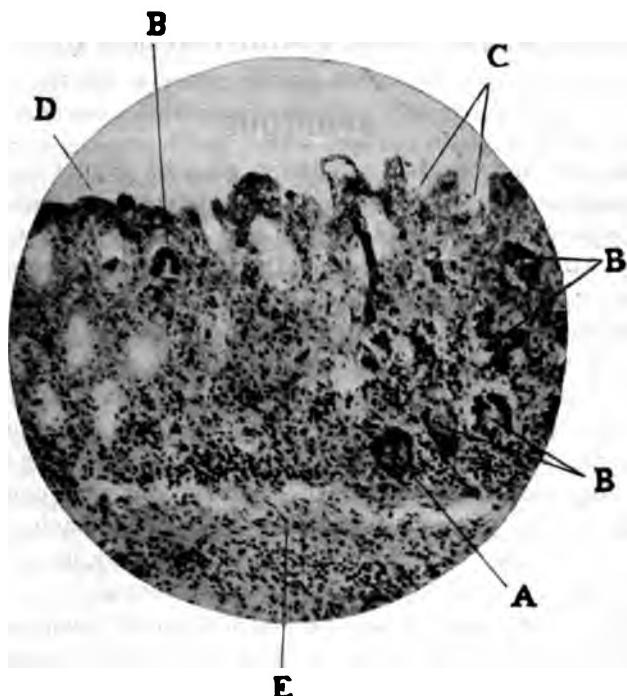


Fig. 108.—Photomicrograph of the glandular layer of the human stomach in a case of advanced atrophic gastritis. At A is shown a cross cut through a gastric tubule in which the normal cell picture is still preserved. The Bs show tubules in various stages of degeneration. The clear spaces in the section represent tubules entirely denuded of cells, and along the free surface it can be noted that the columnar cells are also gone. The infundibula have broken down at C, and at D they are completely obliterated. The entire glandularis is infiltrated with round cells, which are seen thickest in the lower region of the tubules and in the submucosa. Muscularis mucosæ at E. The specimen shows the loss of characteristic structure of the secreting portion of the stomach, and the case showed clinically an absence of all stomach secretions excepting mucus. X 100.

may display glandular elements not entirely destroyed. But when such are seen, the area above them is in such indefinite arrangement that there is so much infiltration around them that plainly such could serve to no purpose in the way of gastric-juice secretion. The

columnar cells covering the surface of the mucosa and lining the alveoli of the glands are completely lost.

It should finally be mentioned that this same picture of mucous destruction may be seen in hypertrophic gastritis, and, as was said at the onset, that different portions of the same stomach may show all of the above-described clinical types. It is to the extent that a certain progressive change predominates that the terms simple, hypertrophic or sclerotic, or atrophic chronic gastritis have been given to designate the type.

#### SYMPTOMS.

As a rule, the onset of a chronic gastritis cannot be determined. The disease usually develops very gradually and insidiously. The initial symptoms are not well marked and thus the condition is usually ignored. After a time, however, disturbances become pronounced and a series of many varied symptoms present themselves. Among these is a sensation of fullness and pressure in the gastric region coming on after meals, with a general feeling of oppression. Dizziness, palpitation of the heart and shortness of breath (*asthma dyspepticum*) may be present. These may be relieved by belching, although a rather steady distress in the stomach continues during the major part of stomach digestion. Sometimes the distress and pain continue when the organ is empty, and on pressure over the stomach an indefinite sense of mild degree of diffuse pain or distress may be complained of. Among the most constant symptoms are the following:—

*Mouth.*—The tongue is coated and the patient complains of a bad taste in the mouth. The latter is most marked after meals or in the mornings, but may be present as a constant condition. Regarding the looks of the tongue, it may be red on the tip and margin with a triangular-shaped coating on the dorsum, or the entire tongue may be soft, pale and flabby looking, showing serrations from the teeth, and generally covered with a thin furry coating. The breath may be tinged with a fetid odor; particularly is this present when the teeth are in a carious state. Catarrhal states of the faucial and oral membranes are common. Among the conditions observed are pharyngitis, postnasal catarrh, and stomatitis. When much catarrhal involvement is present in the mouth, the breath is more offensive, and complaint is made that "foods have no taste." The secondary involvement of the mucosa of the throat is the origin of the so-called "stomach cough."

*Stomach.*—The appetite is fitful in the majority of cases—that is, at one time it is poor and at another much improved. More or less anorexia is usually present. In some cases, again, anorexia is not ob-

served and the desire for foods may be quite normal. Freakiness in the selection of foods is common, and there may be present an absence of the desire for foods of the ordinary and best forms. Among the irregular foods sought are those which are piquant, salty, or acid. A common symptom in this connection is the satiety that comes from just a few mouthfuls of food or drink. Thirst, however, may be much increased, and there may be present increase in the salivary and pharyngeal secretions.

There is usually a sense of discomfort in the stomach variously described as fullness, distention, bloating, a sense of weight and pressure (sometimes this is described as a dull ache but never as a distinct pain). These feelings are caused by food soon after it is taken—not after an hour or two of comfort. Next in frequency complaint is made of belching and frequent eructations of gas, for a long time after meals. Loss of weight is not the rule, but it may occur. Reflex symptoms form a large part of the history. These consist of headaches, remission symptoms of indigestion, heart palpitations, dizziness, drowsiness after meals, lack of energy and general indisposition for exertion.

Nausea is an early and generally present symptom, particularly in the severe states of gastritis. It usually comes on after the meal, but may be present when the stomach is empty. If vomiting of foods occurs, the nausea is relieved for the time being. A burning sensation may be present under the sternum (pyrosis), due to hyperacidity from increased hydrochloric or organic acids in the stomach. At these times there may be present eructations of a sour acid gas or fluid. Distinct flatulency is suggestive of gastric atony or that marked neurotic disturbance is also present. Vomiting of the entire stomach contents is rarely observed, but may occur because of some extreme indiscretion in diet. It is more of a regurgitation of small quantities of stomach fluid, consisting of mucus with particles of food in various stages of digestion. When this is present it is often met with in the mornings before or after breakfast. In alcoholic cases considerable retching and ejection of mucus, bile and saliva are common and characteristic morning symptoms. In atrophic gastritis complete vomiting may be a prominent feature. From the long-continued passing of undigested foods into the intestines an enteritis or a functional disturbance of the liver may be present. This, of course, would add intestinal symptoms to the case. In the well-advanced hypertrophic cases the clinical picture is suggestive of mild degrees of pyloric stenosis, and a diagnosis from diffuse contracting carcinoma may be quite difficult. It may be said in the distinctions between these that in the gastritis cases gastric bleeding is rare, the condition is more of a chronic one, and should a mass

be felt in the epigastrium (hypertrophic stenosis) it would always be small in size and remain sharply confined to the stomach proper. There would also be absence of collective vomiting, since these stomachs are always contracted and unable to hold more than a small amount of nourishment at any one time. The X-rays usually decide the distinctions.

*General Nutrition.*—In early cases the appearance of the patients is quite good. They look well nourished and one would hardly suspect that a state of chronic gastritis existed, even as I have seen in a few rather advanced cases. In the course of time, if attention is not given to the condition, inevitable change in the general nutrition and the state of health ensues. This, as von Noorden has suggested, is partly due to "most dyspeptics not eating enough." While this is true in the main, cognizance should be taken of the fact that, because of the degenerative change in the stomach and the enteritis which may ensue from the disturbance in gastric secretion and extension onward, the general health may suffer even when sufficient food is taken. In the atrophic cases there is present a moderate degree of progressive anemia, resembling a minor degree of the pernicious type. The lancinating pains present in the stomach after eating, and the loss of gastric and intestinal function (gastro-enteric atrophy) often make increased feeding in these cases an impossible or dangerous matter. One should always look at the dual side of this subject in advanced cases of gastritis.

*Bowels and Urine.*—The bowels are frequently found affected. The common state is constipation from atony, which, in the advanced cases, is most obstinate. A diarrhea may exist, particularly in those who drink heavily of beer or ale, or who have much intestinal fermentation and putrefaction. Alternating periods of constipation and diarrhea are occasionally met with; these cases, in my belief, should be looked upon more as conditions of constipation in which the diarrhea is a secondary matter to the constipation. The urine is usually rich in urates and phosphates, indican is commonly present, and albumin, renal casts and cellular elements may be found in long-standing cases. The latter designates a chronic nephritis, a not uncommon accompaniment in long-standing cases of the atrophic type.

#### GASTRIC ANALYSIS.

While the diagnosis may be suspected from the clinical symptoms, a gastric analysis should always be made. This comprises the microscopic and clinical analyses of test-meals, of lavage water, or saline instillations from the empty stomach. Such examinations are not only necessary for the purpose of diagnosing a state of chronic gastritis, its

type, and the proper treatment to be instituted, but are important in the prognosis and to watch results which are being obtained from therapy. Fortunately, much definite information can be derived from these laboratory findings, which, for the purpose of practical distinction, may be offered in the following types of cases:—

**Simple Gastritis.**—One hour after an Ewald test-meal the gastric contents show a lessened degree or in rare instances an absence of free and combined hydrochloric acid, a low total acidity, a juice of low enzymatic power, increased amounts of incorporated mucus, and the food is more or less imperfectly digested. The total quantity of extraction may be normal, or somewhat larger (70 to 150 cubic centimeters), and macroscopically the roll is found in large particles and the crust of the roll or bread in large pieces (poorly digested). When the acid secretion of the stomach is low, erythrodextrin is present in small quantities, while achroödextrin and sugar are abundant. This is due to the absence of the inhibiting effects of the hydrochloric acid on the salivary content and the more complete digestion of ptyalin on the starches in the stomach. The fasting stomach shows the rather constant presence of mucus and leucocytes in increased amounts. Sometimes with the normally present squamous epithelial cells, those from the stomach surface or tubules may be seen; these would be seen occasionally as columnar or more often rounded cells usually fixed in the shreds or rolls of mucus.

In moderate cases, the total hydrochloric acid falls to about one-half ( $30^{\circ}$ ); in marked cases it is less or absent. As the acidity falls, with it the enzymatic content is reduced, although it may be present in increased amounts above the hydrochloric acid. Quantitative tests of the zymogen should always be made when the acid is low, for it is a practical fact, that upon this more than on the reduction of hydrochloric acid depends the diagnosis of the degree of gastritis and prognosis. I am of the opinion that changes in hydrochloric acid secretion are more sensitive to gastric disturbance than are those of the ferments, and that general conditions, when the stomach is normal, can easily change the acidity while the pro-enzymes may be present in normal or only slightly reduced amounts. The zymogen secretions are the more specific functions of the stomach, to which the acid may be said to be auxiliary. Thus it is that when the pro-enzyme continues low (pepsinogen) it may be deemed that destructive changes have taken place in the glandularis and in the most numerous tubular elements in particular—namely, the central cells. The acid curve on fractional analyses corresponds to the Ewald method—low acidities plus excess of mucus.

In the estimation of the quantity of pro-enzyme the complete peptogenic or the milk-curdling method may be used. For the pepsinogen and pepsin, the time-honored thermostated, water-jacketed chamber with the employment of Mett tubes in the filtrate answers well for the qualitative and quantitative estimations. The apparatus recently advanced by Einhorn, which is a simplification of the Jakoby-Solms ricin method, answers to fair purpose; it is simpler, quicker, does not require a thermostat, but is not very accurate. The details of performing these tests and the following have been described. A quicker and simpler method and one of much value in ordinary clinical procedure is the simple test of quantitatively estimating the total enzymatic content by means of the amount of milk-curdling power present. It may be taken as a standard that where the zymogen is present in  $\frac{1}{160}$  dilutions much advance in destruction in the glandularis had not taken place, and that the results from treatment (and therefore the prognosis) are good; when it is necessary constantly to use a  $\frac{1}{80}$  to  $\frac{1}{40}$  dilution to obtain the reaction the prognosis is uncertain; and when it is not present in dilutions under these, particularly under  $\frac{1}{20}$ , the prospect of recovery is slight. It is desirable to make the complete pepsin estimations with more definite tests when close accuracy is desired, for one test may be somewhat different from another, and if both were alike they are always of value as confirmatory.

What may be classed as the simpler forms of chronic gastritis are those which present changes from the above in the following manner: Cases are seen which show an excessive secretion of hydrochloric acid (*gastritis acida*). These resemble in the amounts of acid a hyperchlorhydria with an increased amount of mucus. And because of this excess acid with enzyme, the gastric findings and clinical course are more of sthenic ones. In these cases, less importance should be placed on the gastric findings in the way of the acid-enzymatic content and its result on changing the macroscopic and chemical findings of the test-meal, and more should be placed on the amount of incorporated mucus and evidences of free cellular elements in the stomach. The distinction of this type of gastritis is important in a therapeutic way, since measures for the control of this excess of gastric juice secretion are important for medical relief, but not in the sense of prognosis. This type of gastritis is less a type of the common condition than those which begin in an asthenic manner. It represents oftener, in my belief, a hyperchlorhydria causing a secondary gastritis rather than a gastritis as a primary condition causing or being accompanied with a hyperchlorhydria. Still, it is possible that a chronic

gastritis may in some irritative way cause an increased acid secretion for a while, and a neurotic, a pure irritative condition, and organic disease might exist as somewhat associated conditions at the same time. The point here is difficult to prove, but there is no doubt that definite measures employed for the treatment of hyperchlorhydria are more successful in a curative direction than those employed for a gastritis alone. The latter, however, in the beginning of treatment should not be neglected, for it is not so very rare that a long-standing gastritis acida may finally terminate in complete organic change of the glandulature and present itself as a true atrophic gastritis with no acid or enzyme or even mucous secretion in the stomach in the course of time. In these cases, while the increased amounts of acid and mucus are important in the diagnosis of gastritis acida, the examination of saline instillations or lavage water are more valuable in the estimation of the degree of actual chronic gastritis that is present. This form of gastritis is especially seen when there is a complicating gastric atony. The organic acids are not present in the stomach contents when the HCl is high. I do not recognize the so-called gastritis mucosa or mucipara as a distinctive clinical type of chronic gastritis. In the hyperacid type of chronic gastritis high and continued acid lines are seen in fractional analyses plus excess of mucus.

**Hypertrophic or Sclerosing Gastritis.**—The stomach contents show the presence of food remains in various states of digestion and fermentation. Hydrochloric acid is markedly reduced in the free and combined acid; the organic acids are present in definite amounts, particularly when benign stenosis of the pylorus exists. Because of the contraction of the stomach as a whole in late cases, the test-meal return is small in amount (30 cubic centimeters or less). In other cases, again, when the hypertrophy affects mainly the glandularis and submucosa, the chamber of the stomach may be normal in size and even increased; in this event the return may be doubled or trebled. Food remnants and mucus may be present in the fasting stomach, since motility is usually tardy. Clinically, these cases are the same as those of the relaxed atrophic variety, for atrophy of the secreting apparatus of the stomach is always present and the gastric findings are like those described below. Blood is rarely found unless catarrhal ulcers are present, and then it is small in amount. Points of some clinical value in making a distinction between the sclerosing and atrophic forms are the presence of mucus and food in the morning stomach of the first and the fact that the sclerotic stomach will not permit of the taking of large meals. When the organ is contracted and the pylorus hypertrophied, stagnation is noted when solid foods are taken, but not with fluids.

Furthermore, moderate stagnation may be present at one time and not at another, suggesting that more or less pylorospasm comes and goes with the narrowed pylorus. Hypermotility is never present, and the peristaltic waves are shallow and flat. The sclerosed stomach is small and triangular in shape, and the pylorus situated high and to the left of the spinal column. These stomachs are generally achylic.

**Atrophic Gastritis.**—The fasting stomach is usually empty, both of food remains and mucus. The stomach here is merely a receptacle for food, and hydrochloric and even the organic acids, the proferments and mucus all are absent (although the latter may be present to some extent). The Ewald test breakfast at one hour extraction and fractional shows achylia and an absence of digestion, and, after being in the stomach an hour, still smells like roll or bread. Leucocytes and bacteria are present in increased amounts, and free nuclei are but rarely found. The return is usually increased in amount from the absence of gastric juice insuring stomach digestion and interference with the motility, but if the pylorus is relaxed the return may be small. Of great value in diagnosing atrophic cases is the presence of free gastric cells in the fasting stomach. Quoting part of a recent article of mine in which I drew attention to this, and in which I described the method employed in obtaining and staining for them, I present the following<sup>1</sup>:

In the atrophic conditions this is made possible by a careful examination of the numbers, the type, and state of health of the gastric cells found free in the stomach. The text-books on the diseases of the stomach do not give significance to the value of such examinations. Here it is evident that we deal with the organic cells of the tunica propria itself, and the technique, as well as the method of examination, is simple. Since they cannot readily be made out in the thick mass of a test-meal, the stomach must be empty when we go after them, and this means the lavage of the jejunum mornings after a light supper taken early the evening before and a night of freedom from digestion. By these means the cells when exfoliating from the free surface of the stomach or desquamating from the tubules will collect during the night in sufficient numbers for their discernment.

The technique that I have generally employed, and which was followed in the two cases herein reported, is the same as that described by me previously ("Gastric Exfoliation as a Feature in the Production of Acute Gastric Ulcer," Medical Record, November 30, 1907). It is desirable to begin by aspirating the empty stomach before the ingestion of the compound saline solution. For this purpose I employ my regular test-meal bottle. The disturbing factor in the examination of such aspirated fluid as may be obtained before the giving of the saline water is that generally this fluid contains too much mucus for a careful scrutiny of the cells. Still, they can often be made out and then they are found not so much changed as they are liable to be when drawn hours later from the standing wash water, even when the compound saline solution had been employed. When any organic cells outside of the living body are subjected to the continued action of water they usually undergo a hydrolytic process, swell, change in contour, and do not stain as definitely as when in the tissues or when freshly drawn. The gastric cells are

exception to this rule. To prevent this, in so far as it is possible, it is desirable to employ for the washing purpose a solution which in character and specific gravity approximates that of the blood. This is done by the addition of salines. The instillation that was used contained 250 c.c. of water to which were added 21 grains of sodium chloride, 1 grain each of sodium sulphate, sodium carbonate, and sodium phosphate. This is drunk, the patient is made to exercise vigorously, or the fluid is agitated in the stomach by sharp taps with the hand upon the abdomen over the gastric region, it is aspirated after five minutes and permitted to stand for several hours, the upper part of the fluid is syphoned off, and the sediment, in

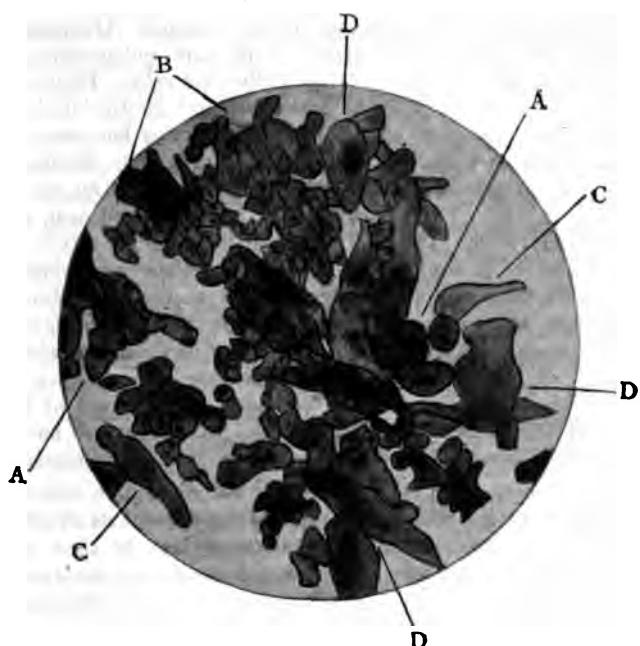


Fig. 109.—Photomicrograph of the centrifuged sediment of washwater from a case of atrophic gastritis, showing numerous cells which had been shed from the gastric tubules. *A*, *A*, The acid cells; the *A* at the right side of the cut points to two groups of the acid variety; below and to the right of the lower collection is seen a cast from a gastric tubule. *B*, A large collection of central cells; this group extends to the center of the photograph. *C*, *C*, Columnar cells, probably from the free surface of the stomach. *D*, *D*, Squamous cells from the canal above the stomach.  $\times$  about 450.

small lots, centrifuged for examination by the microscope. The stains which have proved me best are  $\frac{1}{2}$  per cent. aqueous eosin, 1 per cent. methyl-eosin and hematoxylin, Biondi's polychrome methylene and carbol-fuchsin. I would recommend for general use eosin and hematoxylin in separate solutions. (Later observations show that it is best to centrifuge the saline solution immediately after withdrawing from the stomach.)

The acid cells from the stomach stain readily with most of the aniline dyes. In size they are between the leucocyte and squamous epithelium and their main

features are the stippling of the cell protoplasm with eosinophilic granules and the well-defined nucleus. In shape they may be described as irregular, although most of them are oval. With the eosin and hematoxylin stains, which serve well in differentiating the acid from the peptic cells (the first taking the eosin, the latter the hematoxylin), the nuclear membrane is usually well defined. The nucleus itself is usually lighter and a trifle larger than those in the peptic cells and stains in a blotchy way. These cells when desquamating in numbers are easy to find, and upon their presence the main dependence must be placed in the diagnosis of atrophic gastritis.

The peptic cells offer much greater difficulties in finding and discrimination than do any of the other organic elements of the stomach. They stain poorly—the body just barely, the nucleus much better. With care and patience in the search they can often be seen, but never as plainly as the acid cells. Their cell protoplasm is indistinct and with the hematoxylin stain is found faintly bluish in color. At best they take eosin or in fact any of the aniline stains but very poorly. Their nucleus stains deeply and generally uniformly throughout. Neither the nuclear membrane nor nuclear granules can be distinctly discerned. This also differentiates them from the acid cells. The nucleus itself is seldom found oval, as is often the case with the parietal cells. They are much smaller than the latter, being between them and the leucocyte in size, for the mononuclear variety of which they may be mistaken. Because their protoplasm digests away so readily (when the cells are free), and because of their poorly staining properties and the question of their presence even if seen, the search for them need not be continued when numbers of the more plainly recognized acid cells are discovered. Sometimes they take the carbol-fuchsin stain better than they do the hematoxylin. Some of the free nuclei noted are undoubtedly from these cells, because I have seen such nuclei with just a shred or the faintest band of the characteristically stained protoplasm about them.

The columnar cells from the stomach are not difficult to make out. It must be remembered that in the posterior nares and the upper half of the pharynx the epithelium is of the cylindrical variety, and these may be shed and swallowed. The cilia of these cells would serve to distinguish them from the gastric epithelium. They stain better than the peptic cells; although not so well as the acid ones. Their shape is characteristic, their protoplasm is not granular, and they have a long, flat-looking nucleus which is almost midway between the ends of the cell, while in the acid and peptic cells the nucleus is generally nearer to the edge of the protoplasm. They are easily detached by the stomach tube and thus are not so significant in this connection (unless exfoliating in large numbers) as the peptic juice secreting cells would be. They are often found in groups and hematoxylin stains them well.

In cases of atrophic gastritis particularly, there may be seen a ring of cells (cast) more or less complete, which, in my opinion, consists of groups from the depths of the tubules. Sometimes a mass of rounded or cuboidal cells may be exfoliated from the lower regions of the infundibula and these would strongly resemble the above. The goblet cells are rarely found and are not difficult to differentiate from the true columnar.

CASE I.—January 3, 1906. T. B., age fifty-three years. Born in Ireland. Ex-policeman. Family history, negative. Had measles and diphtheria when a child. Fifteen years ago had a tapeworm, which was removed. A second one was removed three years ago. Up to seven years ago he drank intemperately of alcoholic

liquors, mostly whisky; since then he has abstained completely. Other than his gastric trouble he has had no illness.

*Gastric History:* Had stomach trouble for fifteen years. During this time has had intervals of relief, longer in the beginning, but in the past year and seven months the distress has been continuous. First symptoms were feeling of weight and distress in the epigastrium after eating. In the past eighteen months lost 47 pounds in weight. "Began to get nervous just about the time the loss of weight started, now I'm irritable, don't know what I want or what to do, and cannot sleep nights." Has a craving appetite (bulimia) and whenever he takes food has a wild roaring and tumbling sensation in the stomach. Constantly belching gas, which is odorless and tasteless. Feels very weak physically and cannot walk more than a few blocks without resting. Bowels obstinately constipated.

*Physical Examination:* Talks excitedly and has an anxious look. Seems to lack the power of consecutive thought. Weight, 141 pounds. Body shows that he has lost considerably in weight. Skin dry and sallow looking. Examination of heart, lungs, and liver revealed nothing abnormal. Urine contained one-half per cent. of albumin and a considerable number of casts. Has a well-marked gastric splash (three hours after breakfast). Greater curvature of the stomach lies above the umbilicus (prone position). The patient winces on pressure over the stomach and becomes nauseated when pressure is made in the epigastrium. Tongue coated. Was highly nervous and apprehensive during the examination.

Analysis of Ewald test-meal extracted the next morning: Looks well digested. Return 110 c.c. Incorporated mucus not excessive in quantity. Congo and litmus tests negative. Free HCl absent. Combined HCl, 3°. Total acidity, 9°. Starches well digested. Fehling's test for sugar positive and quick. A little lactic acid. A loop of the test-meal taken from the filter paper and examined unstained showed a number of leucocytes and squamous cells, the starches in a good state of digestion, and no Boas-Oppler bacilli. Subsequent estimation of the quantity of enzyme with the Mett tubes and milk showed a very low digesting power of the gastric juice.

The next morning before breakfast I aspirated his fasting stomach and drew out 17 c.c. of thick fluid, which in examination consisted mostly of mucus (most of this was probably swallowed during the night). He then drank 250 c.c. of the combined saline water, which was withdrawn, permitted to stand for four hours, syphoned down to 70 c.c., and which showed the following findings: Acid cells from the gastric tubules present in large numbers; some peptic cells; leucocytes, numerous; free nuclei and mucus present in all fields; squamous cells abundant; some yeast fungi and short rod bacilli found.

*Diagnosis:* Advanced atrophic gastritis and chronic nephritis.

The subsequent history of this patient is worth relating. Under dilute hydrochloric acid, taken one, two, and three hours after his meals, acid gastric douches, a diet free from meats, eggs, and milk, his stomach at the end of two weeks showed a total hydrochloric acid acidity, after an Ewald meal, of 9° (all combined), and a total acidity of 13°. But he complained that he felt no better and had lost another pound and a half in weight. Although the results from his treatment seemed encouraging he felt otherwise about it, so he continued his rounds of private physicians and dispensaries until he landed a bed patient in one of the large general hospitals of the city. Here, a diagnosis of probable carcinoma of the stomach was made, an exploratory incision was performed (nothing malignant or surgical was found), and the patient died three days afterward of an acute

features are the stippling of the cell protoplasm with eosin well-defined nucleus. In shape they may be described as if of them are oval. With the eosin and hematoxylin stain differentiating the acid from the peptic cells (the first to the hematoxylin), the nuclear membrane is usually well defined; it is usually lighter and a trifle larger than those in the blotchy way. These cells when desquamating in number their presence the main dependence must be placed on gastritis.

The peptic cells offer much greater difficulty than do any of the other organic elements of the body just barely, the nucleus much better. They can often be seen, but never as plainly as indistinct and with the hematoxylin stain best they take eosin or in fact any of the nucleus stains deeply and generally the membrane nor nuclear granules can be distinguished from them. The nucleus in the case with the parietal cells, They are similar in size, and the leucocyte is mistaken. Because their protoplasm is free, and because of their presence even if seen, the more plainly recognizable they are. Carbol-fuchsin stain better noted are undoubtedly the shred or the faintest.

The columnar epithelium is of the cilia of the shape is char- looking m<sup>o</sup> the acid. plasm. can't secrete their power. Lower border of the stc texture of the colon and right kidney a organic. No splash on vibrating over hands on shaking the body from side to sic (four hours after a breakfast consisting of An indefinite sense of distress on pressure in t Examination of urine showed a phosphaturia Ewald test-meal extracted two days later. Returns 5 water. Free HCl absent. Combined HCl 100% well digested. Mett tubes showed poor protec 1:20. Many yeast fungi and sarcinæ. of the sediment in the saline water.

Examination of the sediment in the saline water (stand for five hours) showed many acid and peptic cell goblet cell of discolored mucus, an increased amount of leucocytes. Some of the gastric cells were perfect casts of the tubules.

**Diagnosis:** Advanced atrophic gastritis, and anemia.

*Subsequent History:* Under a carefully selected diet, hygienic measures, and intragastric douching with a bismuthate, 1:1000, she improved perceptibly. Dilute hydrochloric acid with her meals had to be discontinued because of the distress it caused. Fully peptonized milk with her meals helped in the general improvement. After four months of treatment she was no longer to be found free in the stomach (on three occasions).

her highest acidity, after an Ewald meal, was found two months after it had been instituted, and was total HCl 17° and total 1908, she again came under observation, having gotten well. The total HCl was then found to have dropped to 10°, and found in the morning stomach as before.

quent one is extension of the process into a chronic duodenitis and diminution of the present attacks of catarrhal gastritis communis choledochus or rectum. Anemia and debility, loss of weight and emaciation are common conditions usually accompanying nephritis may occasionally occur.

A chronic gastritis is one of months or years, the degree of the disease, and the dietetic treatment take of themselves. The course is essentially one of improvements from time to time. With thorough treatment, the mild cases recover; but even in these, dietary indiscretions may cause relapses. In the moderate cases careful dieting may lead to the general state of health delay the advance, while in advanced ones (atrophic or near it) the prognosis of complete recovery or absence of subjective distress is poor. A better prognosis can be given if marked gastric or gastro-enteric atrophy has not occurred.

#### DIAGNOSIS.

This is made from the long course of the disease and the symptoms described. In atrophic cases the low state of general health, corporal and nervous disturbance, anemia and nephritis are of importance. The primary cases should be distinguished from the secondary, the chronic from the simple acute, chronic gastritis from the other gastric affections, and when possible the types of chronic gastritis from one another. As a rule, the primary and secondary forms are easily diagnosed from each other by the absence or finding of well-marked causative disease in other organs; still, when disease of the heart, lungs and kidneys exists, it must not be forgotten that a secondary gastritis might have been engrafted on a primary.

The acute forms are differentiated from the chronic by the history of the single taking of some irritating substance, the acute onset and short course, the more intense picture of illness and distress, the presence of acute nausea, vomiting, eructations and the febrile course. In the matter of diagnosing chronic gastritis from other gastric dis-

exacerbation of his chronic nephritis, induced probably by the ether given at the time of his operation.

CASE II.—April 4, 1907. Miss M. S., twenty-five years old. American by birth and of good family. Occupation, at home. Family history: a maternal uncle died of carcinoma ventriculi at the age of fifty-one years; otherwise negative. Personal history: Was a seven-month child; had variola, scarlatina, and parotitis when a child; began menstruating when seventeen years of age; had typhoid fever at twenty. "Never was strong physically." Habits good.

*Gastric History:* Had stomach trouble for seven years. It began shortly after her attack of typhoid fever and its onset was gradual. At times, when careful what she ate, was comparatively free from distress. Various acute attacks in the past had been diagnosed as "gastritis," "nervous indigestion," and "weak stomach." Always felt best when away from city life. Complains of a sensation of weight and fullness in the epigastrium after meals. When the stomach is troubling her, has much palpitation of the heart. Has often vomited a watery looking fluid (probably mucus). Has many attacks of headaches, pains and tired feeling in the calves of her legs. Has a bitter taste in her mouth mornings. Two years ago, when her stomach was not troubling her especially, she ate rather heavily one evening of chicken salad, after which she was taken acutely ill, had to go to bed where she remained for ten days with a gastric disturbance accompanied with an elevation of temperature and which at the time was diagnosed as "gastric fever." Bowels constipated, but move with small doses of fluid extract of cascara. Has lost no weight.

*Physical Examination:* Weight, 127 pounds. Looks moderately anemic. Heart and lungs normal. Has a systolic hemic murmur over the body of the heart and bruit in the external jugular veins. Blood examination showed 3,400,000 reds, 7000 leucocytes and 73 per cent hemoglobin. Abdomen well formed, but walls have poor contracting power. Lower border of the stomach 2 cm. below the umbilicus. Hepatic flexure of the colon and right kidney also displaced downward. Stomach very tympanitic. No splash on vibrating over the stomach, but slight succussion sounds on shaking the body from side to side. Stomach apparently empty of food (four hours after a breakfast consisting of orange juice, a roll, and hot milk). An indefinite sense of distress on pressure in the gastric region, but no actual pain. Examination of urine showed a phosphaturia, otherwise normal.

Ewald test-meal extracted two days later. Returns 55 c.c. and looks like fine oatmeal water. Free HCl absent. Combined HCl 10°. Total acidity 14°. Starches well digested. Mett tubes showed poor proteolysis and milk-curding reaction 1:20. Many yeast fungi and sarcinae.

Examination of the sediment in the saline water (which was permitted to stand for five hours) showed many acid and peptic cells, a few columnar, one goblet cell of discolored mucus, an increased amount of leucocytes and free nuclei. Some of the gastric cells were perfect casts of the tubules.

*Diagnosis:* Advanced atrophic gastritis, and anemia.

*Subsequent History:* Under a carefully selected bland diet, tonics, general hygienic measures, and intragastric douching with a weak solution of silver nitrate, 1:1000, she improved perceptibly. Dilute hydrochloric acid taken after her meals had to be discontinued because of the distress it caused. The taking of fully peptonized milk with her meals helped in the general digestion of other foods taken at the same time. After four months of treatment, the acid cells were no longer to be found free in the stomach (on three occasions). She gained nine

pounds in weight. Her highest acidity, after an Ewald meal, was found two months after the treatment had been instituted, and was total HCl 17° and total acidity 19°. On January 9, 1908, she again came under observation, having gotten acutely worse a short time before. The total HCl was then found to have dropped to 9° and the gastric cells were again found in the morning stomach as before.

**Complications.**—The most frequent one is extension of the process into the intestines, in that way causing a chronic duodenitis and diminution of the pancreatic secretion. When this is present attacks of catarrhal jaundice from occlusion of the ductus communis choledochus or extension higher up in the gall-passages may occur. Anemia and debility are often present, and in advanced disease inanition and emaciation are commonly seen. An intense general neurotic condition usually accompanies the atrophic cases, and states of chronic nephritis may occasionally be observed.

**Duration.**—The duration of a chronic gastritis is one of months or years. Much depends upon the degree of the disease, and the dietetic and hygienic care patients take of themselves. The course is essentially a chronic one, with improvements from time to time. With thorough and careful treatment, the mild cases recover; but even in these, dietetic indiscretions may cause relapses. In the moderate cases careful dieting and attention to the general state of health delay the advance, while in the advanced ones (atrophic or near it) the prognosis of complete recovery or absence of subjective distress is poor. A better prognosis can be given if marked gastric or gastro-enteric atrophy has not occurred.

#### DIAGNOSIS.

This is made from the long course of the disease and the symptoms described. In atrophic cases the low state of general health, corporal nervous disturbance, anemia and nephritis are of importance. The primary cases should be distinguished from the secondary, the chronic from the simple acute, chronic gastritis from the other gastric affections, and when possible the types of chronic gastritis from one another. As a rule, the primary and secondary forms are easily diagnosed from each other by the absence or finding of well-marked causative disease in other organs; still, when disease of the heart, lungs and kidneys exists, it must not be forgotten that a secondary gastritis might have been engrafted on a primary.

The acute forms are differentiated from the chronic by the history of the single taking of some irritating substance, the acute onset and short course, the more intense picture of illness and distress, the presence of acute nausea, vomiting, eructations and the febrile course. In the matter of diagnosing chronic gastritis from other gastric dis-

turbances much may be said. The characteristic picture of *ulcer*, carcinoma, and the neuroses should be kept in mind, always remembering that a chronic gastritis might ensue from any of them, or that it could have existed before these conditions developed and not directly be the cause of them—particularly ulcer and cancer. As a practical fact when ulcer or cancer can be diagnosed or is strongly suspected, the diagnosis of the more serious condition should always be



Fig. 110.—Case of secondary chronic gastritis due to endocarditis with failing cardiac power. Photograph showing a slight bulging of the epigastrium due to liver enlarged by passive congestion. A line shows the lower border of the liver, which was soft. Patient gave a history of only a digestive disturbance and was not aware of the existing heart condition. Gastric carcinoma had been diagnosed by one observer—the history, mass in the epigastrium and absence of HCl in the stomach were probably factors in this. Further misleading features in the case were a very infrequently heard soft blowing cardiac murmur (heard only when the patient was in the recumbent position) and a fair quality of pulse. The achylia was due to the passive congestion. Patient made a good recovery in bed and on heart tonics and ceased to complain of digestive disturbance afterward.

made, and the gastritis looked upon in the lesser light. Frequent test-meal examinations will usually distinguish the true neurotic disturbances from gastritis. The presence of much mucus, gastric, epithelial and tubular cells, leucocytes, and low states of secretion in the way of hydrochloric acid and pro-enzyme speaks for a chronic gastritis. In the neuroses of a depressing nature more difficulty would be encountered,

and more reliance should be placed on examining for evidences of free organic elements in the stomach and quantities of gastric mucus than upon low states of acid-enzymotic secretion.

In ulcer the pain is more acute, sharply localized, and increased on taking foods (particularly the coarser varieties). Hemorrhage from the stomach and vomitus containing much HCl are not seen in chronic gastritis. The test-meal analysis usually shows hydrochloric acid and enzyme in increased amounts, and a smaller return of the ingested test-meal caused by the hypermotility of ulcer is of further help. With the chronic forms of ulcer more difficulty will be encountered. Here the states of gastric secretion may be low, including even mucus. The distinction then would be between chronic ulcer and late chronic gastritis. A past history of acute ulcer and the degree and character of pains are important, for in atrophic gastritis the pains are more diffuse and not so intense or frequent as they are in chronic ulcer. The X-rays and fecal examinations may be most helpful in differential diagnosis. From carcinoma the differentiation may be difficult, but possible when the series of test-meal examinations, described under diagnosis of early gastric carcinoma, are performed, and when its X-rays and fecal examinations are made use of. When a tumor is palpable, the gastric contents characteristic, and the general and other local symptoms of cancer are present, differential diagnosis is easy. The cases of hypertrophic gastritis which present a tumor cause much difficulty. The history of slow onset and the small, smooth, round, movable tumor, always remaining about the same size, would suggest a benign condition. At any rate, as surgery is indicated in pyloric stenosing hypertrophic gastritis as well as in early cancer the distinction is not so important.

Amyloid degeneration of the stomach is always a secondary disease, occurring as a result of long-standing suppurations, tuberculosis, syphilis, and more rarely in leukemia, lead poisoning and gout. The condition may manifest itself clinically as a chronic gastritis, and complete suppression of the gastric secretion may be present. Under such conditions, with the history of other disease, and if the existence of amyloid disease can be established in the liver, spleen, or kidneys, its presence in the stomach may be assumed.

#### PROGNOSIS.

Chronic gastritis is a tedious disease possible of cure in the average case, possible of staying the progress and immediately relieving the subjective symptoms in the more advanced cases, and absolutely incurable and often discouraging to treat in the completely atrophic ones, in which

it must be said that, when the intestinal mucosa is not involved or only slightly so, benefit, particularly general, may accrue from careful and steady medical attention. The less the quantity of running acid-enzymatic content, the more serious the case. The quantities of mucus present are not so much of a factor in forecasting this, since mucus is developed from the epithelium of the stomach and probably not at all from the parenchymatous cells of the tubules. The above remarks refer to cases that are properly treated, and which continue under proper régime afterward. In those who after treatment again become indifferent to matters of proper eating and drinking, relapses are very liable to occur, and a further degree of gastric change may take place with each of such acute exacerbations. The secondary cases improve if the causative disease can be benefited.

#### TREATMENT.

**Prophylactic.**—The prevention of the disease implies avoidance of the causes which are liable to develop acute and chronic gastritis. Among these in part may be mentioned hasty eating and overfeeding, excessive drinking of iced drinks, the abuse of alcohol and tobacco (particularly chewing), bad condition and insufficient number and alignment of teeth, careful and long enough treatment in the dietetic way in acute gastritis, and close attention in the handling of cases of chronic disease of the heart, lungs, liver, and kidneys so that chronic gastritis is not liable to develop. Successive attacks of acute "bad stomachs" following the long indulgence of late evening heavy meals, or debauches in alcoholic drinks, usually develop first acute gastritis or neurotic disturbances and then a chronic gastritis in the end. A person who has passed through the course of an infectious or any long-standing disease may develop a chronic gastritis, either as a concomitant disorder in the stomach caused by the disease, or returning to the eating of foods improper for easy digestion before the stomach is capable of a normal power of digestion. Abundant and excess caloric feeding for the purpose of establishing and storing up vitality, strength and weight during convalescence can always be safely met by using the fluid and softer forms of food, or the more solid varieties in proper states of fine subdivision.

**Lavage.**—The results from lavage are extremely good, and, when combined with dieting, form the valuable combination of treatment. The most beneficial effects of washing the stomach are the dissolving and removal of both the free and adhering mucus, the removal of the mechanical embarrassment and the irritating delayed or stagnant food contents, and the healthful stimulating effect it has on the glandular activity of the organ. It cleanses the organ in a surgical

sense, and thereby prevents involvement of the intestines, and thus is an almost indispensable mode of treatment. When mucus is removed late in the washing it proves that it is freed from the mucosa. This removal is facilitated by allowing the water to run in under some pressure, a beneficial thing to do when atony is not present. The Leube-Rosenthal method is the best for accomplishing this, and in a positively empty stomach the gastric spray douche may be used with advantage. But when primary atony exists, the hand syphonage apparatus is safer by delivering into the organ only small quantities of fluid at a time. The employment of massage of the stomach or changes in position during the lavage are of no essential benefit. It may be said that when the residual lavage water is from 500 to 1000 cubic centimeters, marked atony of the stomach or a relaxed condition of the pyloric sphincter exists (permitting the escape of the water into the intestines). In the first, the weight of the contained water stretches the stomach walls, and is injurious. In the second, the sudden influx of much water may be beneficial for a short time but in the end is injurious to the intestines. As Lockwood<sup>2</sup> has pointed out, when the residual water is due to primary gastric atony, an introductory treatment of intragastric faradism will strengthen the stomach to such a degree that lavage without having an excess of residual water becomes possible.

The best time for lavage is mornings before foods have been taken. In rare instances when the mucous secretion is high, a second late evening washing may be essential to get this excess secretion quickly under control. In mild cases or when benefit from lavage is definitely established, every other or every third day is sufficient. A short period of gastric rest after the lavage is desirable, and for this reason it is sometimes more convenient to lavage an hour or two before the evening meal. In other cases again its performance is best in the evening (9 or 10 P.M.), before the night's rest. The latter is the ideal time when, after the lavage, we put a mechanical sedative to the mucosa into the stomach, like the bismuth salts, cerium oxalate or the insoluble and bland magnesia combinations.

In the matter of solutions for the purpose it may be said that better results in the removal of adherent mucus comes from the alkaline solutions than from plain sterile water or normal salt solutions. For this purpose there may be used 3 tablespoonfuls of sodium bicarbonate or 2 ounces of lime-water to 2000 cubic centimeters of warm water. Following this for its astringent and stimulating effect on the mucosa when much mucus is being secreted a 1:10,000 solution of silver nitrate may be used. Care should be exer-

cised that the stomach is empty after using this (argyrism) and it should not be kept up for more than a dozen or so washings. As the case progresses and the mucus seems to be lessened, it has been my practice to use with the discutient and antacid alkaline water, or just in solution alone, a weak solution of tincture of hydrastis (30 to 2000). While I confess to the empirical element in the employment of hydrastis, from its frequent use, I am convinced that much benefit can accrue from it in chronic catarrhal states of the gastric mucosa. The fluid-extract may be used in place of the tincture in about 4 or 8 cubic centimeter quantities in like dilution. For the purpose of stimulating hydrochloric acid secretion late in the treatment 12 to 2000 hydrochloric acid may be used; freshly made solutions should always be used. It will be noticed that 2000 cubic centimeter quantities are suggested in all of the above. This is because most cases cannot be washed clean and the benefits are less with only pint, liter, or 1000 cubic centimeter amounts. The addition of antiseptics, like salicylic or boric acid, thymol, benzol or resorcin, are not necessary. When atrophy of the glandularis is complete no direct benefits can or ever do come from lavage.

Dietetic.—The regulation of the diet is of great importance in the treatment, and a diet list based on the chemical condition of the individual's digestive power and free from substances which might irritate the mucosa should always be given and its observance insisted upon. The best plan to follow until the symptoms abate somewhat is a fluid or semifluid diet consisting of bland and easily digested substances. Among these may be mentioned milk, kumyss, matzoon, rice, farina, sago, soft eggs, thin soups, mashed potatoes or soft vegetables in purée or cream, spinach, scraped or finely chopped meats, not very fresh bread, toast, butter and cocoa, etc. In a week or two the diet should be added to by including articles of a more solid nature. The eating of meats, rough vegetables and fiber-bearing cereals (like oats) should be resumed with caution, and it is best for these to be severely limited. Stimulants, highly seasoned food difficult of digestion (pork, new veal, corned or smoked meats, lobster, salads, pickles, cabbage, cucumbers, etc.), too hot or too cold drinks, coffee or strong tea should not be used. In those accustomed to it, the breakfast cup of coffee may be continued, but none after that during the day. In normal or increased acidity the protein-bearing foods are allowed, while if the acidity be low, only the softer forms, like fish, eggs and milk should be used, and the carbohydrates and cereals increased both to spare their proteins and because of the better digestion of the starchy substances. In severe cases, only the fluid or finely sub-

divided foods should be allowed. In constipated cases the soft green vegetables, fresh fruits, honey and buttermilk, etc., are of service.

As to the number of meals a day much depends upon whether atony is present or not. If it is, frequent meals (four or five a day) and each of small amounts are best. If it is not, the usual custom of three meals in a day is best. Three meals of smaller quantities are always better than only two larger ones.

The teeth should be looked after and insistence be placed upon slow eating, thorough chewing and complete insalivation before swallowing. Disturbing thoughts at the table should be avoided, and for this purpose congenial company is helpful. The well-nourished, habitually overfed patients should stop eating when a feeling of satiety occurs, or should accumulate a fair amount of food on their plate before beginning to eat, and stop when this is consumed. Alcoholic drinks and bitters in any form had best be forbidden absolutely. The general health should be closely watched, and when this is low or fails, more food should be allowed.

A dietary which answers for the slight and moderate case is the following: The general plan of the diet is to eat three fair-sized meals a day, at regular intervals and not too hurriedly, taking about the same quantities of food at each time, so that one meal is about the same size as another, and avoid mixtures of many foods. The foods that should not be eaten are those having pits, seeds, or skins; nuts in any form; anything highly spiced or containing much condiment; soups and coffee; oatmeal; tough meats and poultry; rough vegetables, such as cabbage, cauliflower, sprouts, etc.; stews, hashes, and made-up dishes, and food and drinks that are too hot or too cold. The foods to take are: Consommé, bouillon (very small amounts), eggs in any form, and two at a time may be eaten as often as twice a day. Fish is very wholesome, but it must be fresh and always boiled or roasted, never broiled or fried. Smoked, pickled, or canned fish should not be eaten. Beef, lamb, mutton, chicken, and game should be eaten only in moderate amounts once a day or in small amounts twice a day. Meat at one meal and fish at another on the same day is also a good practice. The meats must be roasted or broiled, although chopped raw beef may be eaten with a little salt if necessary; these should always be cut on the plate as fine as possible, cutting the fibers crossways, and should in addition be well masticated before swallowed. Breads, rolls, and plain cake when not too fresh are allowable at all of the meals, and plain fresh butter in large quantities may be eaten. The best vegetables are peas, beans, mashed potatoes, or baked sweet potatoes. Any of the salads (lettuce, watercress, romaine, etc.) can be eaten with a little vinegar, salt to taste, and good quality of olive oil. Any

desserts made of the cereals, butter, milk, or cream can be employed. Fruits and berries in any form should not be eaten. Pastries and pies also are not allowed. The best drink at the meals is plain cold water and this should be drunk after the meal is over.

After the course of treatment, a diet list of "must not take" serves the best purpose. It is simpler, less difficult to follow, and less easily forgotten. In this connection the following is offered: Foods that will be essentially injurious and must not be partaken of are: one- or two-minute cooked breakfast foods; the rough vegetables—cabbage, sprouts, cauliflower, artichokes, asparagus, beets, celery, corn, cucumbers, kohl-rabi, onions, and tomatoes; foods which contain pits, seeds, skins, or nuts; canned and smoked beef or fish; lobster, crabs, shrimps; cheese of any kind excepting Philadelphia or Neufchâtel; too much pastries, especially those cooked in molten fat, like doughnuts, fritters, etc. Foods that are too sweet, such as jams, etc.; also fruits, cherries, cranberries, figs, grapes, muskmelons, and much coffee, strong tea, alcoholic and malt beverages.

**Balneological.**—The use of proper mineral water for the case is of much value for the reason of its action in stimulating glandular activity on the one hand, and neutralizing high acid secretions on the other, as the case may be. To stimulate secretion, the saline waters and those containing carbonic acid gas are of the most service. Among these may be mentioned Kissingen (Racoczy), Kochbrunner, Homburg, Fachingen, Soden, or the American carbonic acid charged water of Saratoga (Congress Spring). When the cells are destroyed these waters are of no benefit. When the acid content is high the alkaline waters are useful. Among these are Vichy Célestine, Weisbaden (Kochbrunnen), Victoria-Brunnen, St. Galmier and Saratoga (Hathorn). In anemia and atony, Levico Mild, Mitterbad, Orezza, Schwalbacher, or Stahlbrunner may be used. In constipation Carlsbad, Villacabras, Pluto, or Mt. Clemens Bitter Water, although it is better to get the bowels to move by dietetic and hygienic means, or by enemata of small amounts of olive oil instilled into the rectum each night, or saline enemata during the day. The saline waters should be drunk before and the alkaline and ferruginous during or after the meal. The aperient water should be taken on an empty stomach, preferably before breakfast. Patients of a nervous or debilitated nature should not be given purgative water. The reason that sojourners at foreign spas with chronic gastritis improve so markedly is not so much because of any direct beneficial effects from the drinking of special water or the taking of same in a fresh state as it is to the freedom from business and worry while there, the more regular régime in eating and rest, the better selection of foods, absence from drinking dissil-

pations, the outdoor life, and the large quantity of water partaken of causing the steady washing of the stomach and emunctories of the body.

**Baths.**—A morning cold sponge bath is of much service in the depressed cases and in phlegmatic people. It has a beneficial effect on the entire body in the way of increasing tissue resistance by stimulating cellular oxidation, and in many instances improves the general status of digestion. For this purpose, cool plain water of about 60° F. may be used, although the addition of salt is desirable for its greater tonic action. For the latter, sea or table salt in proportions of 1 pound to 10 gallons of water is about right. My experience with the salt-water baths has been that patients sensitive to the application of cold react quicker and that it has a more exhilarating effect than when plain water is used. Thus it is that these may be used in conditions of low general vitality when plain water would not be well borne. The giving of sprays of a lower temperature than 60° F., standing in a few inches of warm water somewhat mitigates the shock. A cold rub is possible in any home, since only a basin containing the water and a thick towel are necessary. This is to be preferred with very sensitive and nervous persons, since with the application of the wet towel less water is applied and a little rubbing may be employed at the same time to bring on a glow. The warm baths of ten or fifteen minutes' duration may be used for a soporific effect in insomnia and agitated nervous states. The spinal hot sponge bath lasting for fifteen to twenty minutes is valuable to induce sleep. Complete warm baths once a week may be used for the sake of cleanliness.

**Exercise.**—Outdoor exercise is of much value in the care of these patients. Of these may be mentioned walks, particularly in the out-lying districts of the city, horseback riding and rowing. Automobiling is of less value. In the home, gymnastics may be carried on by the use of light dumb-bells, wall exercises, or going through the United States military setting-up exercises for ten minutes each morning and evening. It is well to insist upon the carrying out of these exercises for a remedial purpose or patients will soon become very indifferent to them. To obviate this, a daily visit to a well-equipped gymnasium where company during the exercise is readily obtainable is of service. For our men and women of the upper classes, the recently projected city tennis clubs are to be recommended. When there is visceral prolapse the set of abdominal exercises already given is of value; likewise also any exercise, such as tennis, which brings the abdominal muscles into play. If atony is marked, the wearing of a belt or corset may be helpful in affording relief.

**Rest.**—In the sthenic forms of chronic gastritis the care of the nervous system may require special attention. To this end, retiring early in the evenings, at 8 or 9 P.M., and arranging so that ten or more hours' rest in bed be taken daily are worthy of adoption. In patients who have lost weight and are reduced in strength and vitality, gymnastics should not be engaged in, and a "food and rest cure" may be necessary.

**Electrical.**—The employment of electricity comes next in importance to lavage and dietetics. The use of the faradic current of rather slow interruptions is most beneficial. By its employment the subjective symptoms often ameliorate, and the general tone of the stomach, particularly the muscularis, improves. The galvanic current may be employed in cases of acid gastritis when no atony is present. The intragastric method of administration is vastly to be preferred to that of the percutaneous. The course of treatment should last for two or three months; in the start, treatments every other day, then every third, every fourth, and so on until the relief is permanent. The technique of giving these treatments has been already described.

In nervous cases, in addition to the massaging influence of the faradic current, a marked psychic and general stimulating effect is often produced. In these cases the spinal and neck regions should be treated with the external electrode. In cases of poorly developed and relaxed abdominal walls (ptosis), and when atonic or atrophic constipation exists, the general abdomen should be treated.

**Medicinal.**—With proper dieting, lavage, mechanical treatment, and possibly electricity, there need be little resort to drugs. As our knowledge of the rational causes of gastric conditions advances, medicines seem to be less and less in order. In some instances, however, for the treatment of special symptoms they may be used. Among these is the use of hydrochloric acid to meet the secreting shortage and stimulate the glandularis to activity. Agreeing fully with Ewald as to the value of this acid in these conditions, I still doubt that it need generally be used in 40 or 60 drops of the dilute acid to obtain good results. In some few cases it is advisable, but my experience has shown that in those cases wherein it would seem to be distinctly indicated—atrophic gastritis—such large doses are liable to increase gastric distress during digestion rather than relieve it, whereas 10- or 20-drop doses might be well borne. The best plan of administration is to give from 10 to 20 drops of the dilute acid in a glassful of water, drinking one quarter of the amount at half-hour intervals after the meal. The addition of pepsin to this, or used alone, is of no practical value. Pepsin not secreted fresh from the human stomach

during digestion cannot be made good by the giving of any commercial preparation of pepsin. Its use together with predigested foods should be discouraged.

According to the gastric findings in test-meals, and keeping the pathology of chronic gastritis in mind, the following are worthy of employment. The bismuth salts, subnitrate and subcarbonate, are direct mechanical sedatives to the irritated mucosa. The subnitrate is best for the ordinary case, but the subcarbonate has an alkaline advantage over it for gastritis acida. They should be used in larger sized doses than ordinarily employed (1.0 to 2.0 grams), and the subnitrate should always be taken before meals or when the stomach is empty. One large dose of bismuth subnitrate (3.0 grams) taken before breakfast or at bedtime is an excellent practice in the treatment of these cases. It must be remembered that when constipation is a marked feature in the case or occurs from its employment, bismuth should not be used. In some instances, however, the corrected employment in the following is recommended:—

B Magnesii oxidi .....	10.0	3iiss
Bismuthi subnitratis .....	20.0	3v
Aqua destillatæ .....	200.0	3vj

M. et sig.: Take 1 tablespoonful a half-hour before meals.—Label  
"Shake."

Or in gastritis acida:—

B Magnesii oxidi .....	10.0	3iiss
Bismuthi subnitratis .....	20.0	3v
Mist. rhei et sodaæ .....	200.0	3vj

M. et sig.: Take 1 tablespoonful half or one hour after meals.—Label  
"Shake."

When the secretion of mucus is high, lavaging with silver nitrate solution is beneficial. In these cases it is my custom to first wash out the stomach with 2000 cubic centimeters of an alkaline solution, and then follow this immediately with 1000 cubic centimeters of a 1:1000 silver nitrate solution. By employing an irrigating stand holding a 2000 and a 1000 centimeter glass irrigator, side by side, this is quickly done by having short tubes from each glass jar. When the alkaline solution has been run through the stomach, the tube from that jar is slipped off the Y-tube, and that from the silver solution is put on in its place; a four-armed glass connection holding all rubber tubes is even better, requiring no changing of tubes during the treatment.

In atrophic gastritis when the acids are not well borne, foods suitable for intestinal digestion should be advised and the stomach kept alkaline for this purpose. To these ends soda bicarbonate, magnesia usta, and

dried soda carbonate may be used with the meals, which, it may be said, should be frequent, small in amount and finely subdivided. Pancreatin given along with the alkalies is of value.

**Treatment of Special Symptoms.**—In the treatment other than above described may be mentioned the following: For anorexia—lavage, *nux vomica*, *condurango*, gentian and orexin. For nausea and vomiting—careful dieting and lavage, hot applications to the abdomen, cerium oxalate and chloral (0.15 gram) in chloroform water (4.0 grams). For pain—fluid diet or short abstinence from food, lavage, hot applications, galvanism and bromides. For deficient gastric juice

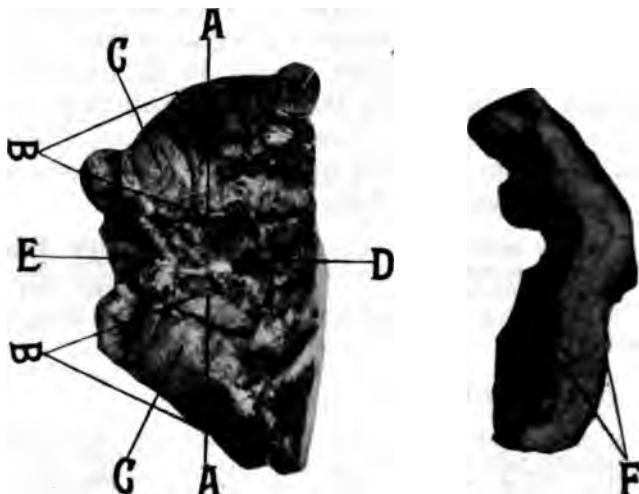


Fig. 111.—Pylorectomy tissue removed in a case of pyloric stenosis due to a hypertrophic gastritis. *A, A*, Limits of the pylorus channel laid open; *B, B*, Showing the thickness of the stomach wall; *C, C*, The hypertrophic and hyperplastic development of the pyloric muscle; *D*, Ulcerated stomach glandularis; *E*, Duodenum; *F*, Showing the thickness of the stomach wall (13 mm.) viewed directly. Specimen slightly reduced in size.

—lavage and dieting, dilute hydrochloric acid, *nux vomica*, gentian, and general tonic measures. For motor insufficiency—electricity, hydropathy, frequent small meals and *nux vomica* or strychnine in rather large-sized doses. For psychic depression—electricity, cold sponge and surf baths, general tonics, high caloric feeding and a sojourn in the country or in a well-ordained sanitarium for digestive diseases. For constipation—proper dieting, electricity, exercise, going to stool regularly whether the bowels move at the time or not, the use of compound licorice powder, cascara sagrada, or rhubarb, rectal enema of salt water, and not at all the strong purgative pills or tablets, excepting only in occasional instances for the purpose of cleansing the bowels.

**Surgical.**—In well-established cases of hypertrophic stenosis, where the pylorus is greatly thickened (stenosis), causing retention, and the organ much contracted, the performing of a pylorectomy is in order. If a pyloroplasty operation (particularly the Finney) can be performed, it serves the purpose better. But inasmuch as the organ may be markedly contracted to the left and away from the duodenum, a pylorectomy may be the only operation possible. Unfortunately, the tissues of the stomach are in such poor condition for union that the mortality is high, even when extra protecting sutures are placed about the joined tissues, this being increased by the fact that these patients mostly are alcoholic and thus cannot stand the operative shock. The usual form of gastroenterostomy should not be performed on these stomachs, for the reasons that the stomach is contracted to a point too far above the duodenojejunal angle for apposition without traction, the stomach continues thickening and contracting after the operation and causes a closing of the communication, and because the offending pylorus is not removed.

#### REFERENCES.

<sup>1</sup> BASSLER: "Significance of Wash Water Examinations for Gastric Cells in the Diagnosis of Atrophic Gastritis—Report of Two Cases," Medical Record, July 11, 1908.

<sup>2</sup> LOCKWOOD: "Practice of Medicine," p. 405.

## CHAPTER XX.

### Organic Diseases of the Stomach.

(Continued.)

#### GASTRIC AND DUODENAL ULCER.

##### PRELIMINARY REMARKS.

SINCE Cruveilhier first pointed out (1829 to 1835) that gastric ulcer was a distinct clinical disorder and not a condition due to post-mortem change as was supposed at the time, this disease has been variously described as Cruveilhier's disease, round ulcer, *ulcus ventriculi*, perforating ulcer, peptic ulcer, simple ulcer, and others. According to our knowledge of the condition to-day, it occurs to me that the terms simple ulcer or peptic ulcer are the best, since these refer to location and the anatomical lesion, and in the second place to the fact that the presence of gastric juice in that portion of the digestive canal is no doubt a prominent factor in the etiology of the great majority of them.

A perusal of the historical records of this disorder proves that although instances of patients with gastric ulcer are available from the sixteenth century (and even suggested in the tenth century), it took from the time of Matthew Baillie in 1793 through the entire last century and up to the present time to have developed the knowledge on the subject that we now possess. Of late years, because of the vast interest and importance of the condition both from the medical and surgical standpoint, the many more skilled workers who have come into this field of study, the advances in measures of diagnosis that have been made, and to the development of upper abdomen surgery (mostly by the English and American surgeons), the subject is receiving world-wide attention.

Statistics in regard to the frequency of gastric ulcer on the whole are quite valueless. The reasons for this are that the presence of the condition in the number of cases that are definite enough to come under clinical observation comprise only the minority, possibly not more than 25 per cent. of all cases that exist. The combined statistics of nearly 400,000 patients show ulcer to have been diagnosed in less than 1 per cent. of the cases, while in the combined statistics of 59,450 autopsies of various series evidences of healed or unhealed ulcer were observed in 4.4 per cent.; I have no doubt that, with the better knowl-

edge of the condition of recent years, this vast disproportion is being materially cut down. Taking the countries in which ulcers are more commonly diagnosed (Germany and England 5 per cent. each, and Denmark 16.5 per cent.), and comparing these to the others (Russia 0.8, Switzerland 2.6 and North America 1.3), I believe that future years will probably show a more even proportion in countries or cities on the same longitudinal lines, and that the cases will be met with more numerously as we ascend or descend from the equator to the frigid zones. It is possible that, according to the habits and environments of people in each community and to the status of medical men in each locality, statistics on this will continue to show variations for a number of years to come. As a cause of death, ulcer occurred in 410 out of 444,564 deaths (Martin); these figures no doubt pertain to the more or less definite and short duration cases and not through all of the sequent conditions.

The disease occurs more frequently in men than in women in about the proportion of 2 to 1, and most of the cases met with are those in the third decade of life, although no age is exempt. In this way it resembles cancer, in which the proportion of male cases usually predominates although here those between fifty and sixty years of age are most liable. It is somewhat more often seen in those who have used alcohol freely, and also in those who have had infectious disease.

#### ETIOLOGY.

**Gastric Juice.**—Considering that no bacteriological constant factor in the way of producing the specific and characteristic lesion in the glandularis has been observed or discovered, I feel that the gastric juice with a low or absent mucous secretion must be considered as the most important factor in the production of ulcer in the great majority of cases. I base this upon the well-known post-mortem change in the glandularis which the gastric juice can bring about (autodigestion), the fact that normal or hyper-acidity is met with in the majority of cases, and its secretion has such a deterrent action upon the healing of the lesion, and that gastric desquamation or exfoliation or erosions are so commonly met with as stomach disorders. The facts, as Ewald, Lenhartz and others have shown, that ulcer can exist with a sub- or an-acidity is no argument against the gastric juice being a direct cause of the production of gastric ulcer. Particularly is this so when one takes into consideration the more important fact that hydrochloric acid even in a normal person is a very variable secretion—at one time high and at another time absent, and what would be a normal acid secretion in one person may for another be a too high or too low

secretion. The acid itself is chemically not able to digest animal tissue, the main enzyme ferment being the essential for this, and it is possible that this product is more directly concerned in the loss of stomach tissue than just the acid, which, even if short or absent, could be replaced by other acids taken in the foods. It is a striking feature that this type of ulcer is only found where gastric juice flows or in the adjacent organs that it comes in contact with, namely, the stomach, the first part of the duodenum and lower end of the esophagus. Nowhere else in the alimentary canal is the same character of punched-out lesion met with. Once beyond the middle portion of the duodenum, the chyme is neutralized and from here down these ulcers are not encountered. When the lower colon is reached, the contents are slow in the passage and usually become acid again from fermentative products, and it is more probably due to this, acting in the presence of stomach enzymes which have been passed down and are incorporated in the feces than to local bacterial infection, that about the same type of ulcer (stercoral) may exist in the sigmoid. In the production of simple gastric ulcer some irregular course of secretion deep in the gastric tubes, or retention of secretion near the submucosa may cause a deprivation of nutrition at that site with a protective thrombosis in the submucous venules or trunks, and that in the process of motility of the organ this damming of circulation may be extended until a considerable portion of the glandularis is deprived of circulation and sustenance and thus is digested away with the production of an ulcer; the fact that these ulcers are essentially a necrosis and are usually situated near the pylorus or in the pyloric region of the stomach where the tension for outlet is greatest, the chyme the most fluid, and the acidity most marked, are somewhat in favor of this being so.

While hyperacidity in itself is generally recognized as an insufficient cause to produce ulcer, on thirty occasions I have observed the development of an acute ulcer in cases in which an excess secretion has been of long standing. I feel that a condition of increased percentage of HCl can damage the gastric mucosa, although I believe that trauma from foods, thermic and chemical agents can also be internal factors. These in a group can be considered as direct causes, while any outside factor, such as anemia, thrombi, emboli, disease of the arteries, lesions of the vagus, and inflammatory changes in the gastric nerves may be looked upon as agents which would lower the resisting vitality of the glandular layer of the stomach to the factors from within.

In a series of 83 specimens of saline instillations that I examined for gastric cells, 29 of which were from 7 cases of excess secretion and 11 from cases of the so-called gastritis acida, I was able to prove that

gastric exfoliation was very much more common than is ordinarily supposed. The columnar cells were on some occasions found in conditions of excessive secretion and sometimes in great numbers in each specimen. In 5 of the cases I found groups of cuboidal or irregularly rounded cells attached, cells which most probably were from the gastric tubules. In one of the specimens, from a case which showed a free HCl 56°, combined HCl 80°, and a total acidity of 111° in the test-meal, I saw a single-sided section through the infundibulum of a tubule with columnar cells on one end, in the middle shorter and wider ones, and at the other end cells from the interior of the gland. It seemed also to be proven that, depending upon the quantity of mucous secretion in a hyperchlorhydria case, the glandular layer of the stomach was protected against the exfoliating work of the acid, for I observed that when the secretion of acid was decreased and the mucus increased to a more normal quantity the exfoliation of the cells subsided. In this connection, I report a significant case which was included in the publication of the observations at the time:<sup>1</sup>

E. M., Sept. 20, 1906. Age 24 years; married; no children; housewife. *History—Family:* Father killed at 47; mother died at 54, cause unknown. *Personal:* Dysmenorrhea since puberty; pneumonia five years ago; drinks four or more cups of tea and one of coffee each day; otherwise habits good excepting confined to the house too much; had gastric disturbance more or less for four years. More distressed during the past three months; habitually constipated. Present—troubled much with eructation and distention after meals, particularly after dinner; has pyrosis and regurgitates acid fluid after meals. Physical examination shows a well-nourished woman; mucous membranes good color; tongue thinly coated with red edges and tip; patient nervous and apprehensive; epigastric distress on pressure; intestines moderately distended with gas; fecal mass in sigmoid. *Analysis*, September 21, 1906. Ewald test-meal, expression easy, return 110 c.c., looks poorly digested, very little odor, no incorporated mucus on gross inspection; total HCl 121°, total acidity 133°. Urine amphoteric and heavy in phosphates, otherwise normal. *Diagnosis*, hyperchlorhydria.

On the morning of the next day, when fasting, drank 240 c.c. of saline solution which was left in the stomach five minutes and aspirated. 75 c.c. of the return was examined and showed as follows: fluid distinctly acid (HCl) and bile stained; no mucus apparent and no food particles visible. After standing three hours specimens from the middle zone were examined in lots of 10 c.c. which were centrifuged for two minutes or more and showed the following findings—large numbers of squamous cells, numerous free nuclei, considerable columnar cells and a few cuboidal ones from the gastric glands, one group of columnar cells (seven or more in number) were seen; cuboidal cells were found in several groups attached; a few sarcinæ, some shreds of mucus, few mucous corpuscles, and particles of detritus. Specimens from the bottom of the stand glass showed the same cellular findings as above stated, excepting that there were more of them with the addition of numerous rolls of yellow-stained mucus, a few vegetable and partly digested starch granules, and more detritus.

On October 7, 1906, I saw the patient, who, under the prescribed high proteid diet and a compound powder of alkalies, claimed she was quite well again, although analysis showed that she still had the hypersecretion and exfoliation of gastric cells.

Ten months afterward (July 9, 1907), I was called to her home and I learned that nineteen days before (June 20) she had been delivered of a seven months viable fetus after the third uterine hemorrhage in five weeks. On June 19, while asleep, she had an exsanguinating hemorrhage, followed by syncope and semiconsciousness lasting for nearly two hours. The attendant diagnosed a placenta prævia, tapped the membranes, packed the vagina with cotton, and on the next afternoon she miscarried. The early post-partum course was normal, excepting that the woman remained obstinately pale and peaked looking. Six days after her delivery she began to complain of pain and distress in the epigastrium after eating. The pains continued, the severity depending upon the character and amount of food she took, until the day before my visit, when, her stomach feeling somewhat better, she partook rather heavily of raw fruits, after which she was seized with severe gastric pain and vomited. The pain grew worse during the night and the next morning after taking a glass of ice-cold milk she vomited considerable blood. The history, the physical examination and subsequent course of illness showed that it was plainly a case of ulcer of the clinical type.

My deductions from the case were that the hyperchlorhydria, from which she suffered more or less for years, caused an exfoliation of the cellular elements of the gastric mucosa. This exfoliation continued, and, like small traumas from food, was not serious as long as the nutrition of the stomach was sufficient to repair the slight abrasions. But when as a result of severe hemorrhage the system became impoverished and devitalized, the resistance of the basal membrane and submucosa was lowered, and, the acidity continuing, an ulcer ensued on an exfoliated area. This seems to me more rational than a blood-clot carried from the uterus which lodged in the stomach, or other assumptions.

**Trauma.**—This may also be considered as a direct cause. It may be externally or internally exerted, the latter arising from mechanical, chemical or thermal irritants. Of these, the mechanical seems to be the most plausible, because by the thermal or chemical agents the ulceration is usually different in character (more superficial and diffuse) and that these ulcers are rarely met with in the fundus where such substances would first exert their influence after having passed the gullet and cardia, which latter, it may be said, are just as amenable to the baneful effects if not more so than the stomach. It is probable that, under favorable conditions of motility in the way of tight approximation of the mucosa to a sharp surface, like that that may be offered by the points of grape and tomato seeds, shells or the lining interior of nuts, certain whole grains, etc., slight trauma could ensue, which, under gastric hyperacidities and thrombosis of the superficial vessels, may be delayed in healing or be the cause of deeper erosion and finally distinct ulcer formation. According to Richardière, traumatic ulcer cases are classed in two groups,—one, the acute cases healing rapidly; the other (because of the condition of the gastric juice), cases

running a course similar to ordinary chronic ulcer. The latter condition in the stomach mucosa and submucosa (which are most vascular structures during gastric digestion) can in the early instance be accompanied by local hemorrhage and later the surrounding infiltration of repair, both of which conditions could cause a functioning inactivity of that portion of the glandularis for the time being, while the normal mucosa elsewhere is secreting its full quota of digestive secretion. It is plausible that in such conditions an autodigestion of the affected portion may occur—probably gradually and through successive gastric digestions—with the formation of an ulcer which is limited in size and shape according to the better status of independent circulation in the glandularis or submucosa at the periphery. It has been shown by Matthes that when bits of mucous membrane were removed there was a tendency of the muscularis in these regions to contract and thereby bring the edges of the mucosa together and thus protect the bared portion against the action of the gastric juice. Food traumas or local circulatory conditions causing erosions occurring in parts of the stomach where the redundant mucous membrane is less of a feature of structural make-up (such as the lesser curvature and pyloric region) offer a greater liability to ulcer, and these are the locations in which the acute ulcer is most commonly found.

An outside traumatic factor, such as violent emesis, severe compression, a direct blow over the organ, or a severe shock to the entire body, may, particularly when the interior layers of the stomach are friable with blood during gastric digestion and the organ laden with food, cause an injury and a dissolution of the mucosa. It is well known that the intestines can be rent through all of the structures from a severe direct or indirect force, and thus it seems reasonable to believe that the stomach, which is also not tightly moored in its intermediate part, could also suffer in the same way, although, no doubt, not to the same degree of severity or danger. It is probable, as Ackerman has shown, that epigastric compression is a considerable factor in producing ulcer; among such may be mentioned the instances of ulcer in women who use the fashionable waist-compressing corset which does not allow the lower and intermediate portions of the organ to distend when foods are taken and thus presses upon the pyloric region, particularly when this is low, and tailors and shoemakers, who, because of their positions and occupations, are subjected to upper abdomen pressures.

Among the indirect causes may be mentioned the several factors which could lower the resistance or possibility of repair of the glandularis.

**Circulatory System.**—S. and W. Fenwick, Riegel, Mayo and others hold that a definite relationship exists between ulcer and chlorosis and anemia. Whether the sequence, as Riegel suggests, is brought about by the hyperacidity that is so common in chlorotic anemia, or, as Cabot and Stengel have stated, that the anemia is secondary to unrecognized hemorrhages it is impossible to say. It is probable that each of these views is correct in individual cases, although as far as can be gleaned from clinical observation to-day the view of Riegel answers best for the majority of instances. Kawamura's research seems to establish the presence of an antipepsin in the circulating blood which prevents the gastric juice from digesting the stomach walls. Only when there is some interference with the blood-supply, shutting it off from a certain area, is the corroding juice able to exert its destructive action on the tissues. A gastric ulcer is thus primarily the result of shutting off part of the blood-supply from the wall of the stomach at this point. There is no doubt that in the largest number of cases seen anemia is present, and that the treatment of this is a most important factor in the cure of the ulcer. Mayo believes, and I have proven this to be so in my own observations, that by treating the anemia one can often cure the ulcer. I personally believe that anemia should be viewed as an indirect cause in the way of lowering resistance to the effects of gastric juice or the ability of repair of stomach abrasions.

Arteriosclerosis and endocarditis are considered as factors in a number of cases. Howard observed that sclerosed vessels were marked in 48.8 per cent. of his cases, and others have reported the same, but usually in lower figures. According to information in clinical work that can be gained by the examination of the palpable arteries and observations with the sphygmomanometer, I am convinced that Howard's statistics are high for the average case. Most of my patients were rather young to expect much if any arterial change, and endocarditis was not encountered as a relative factor. It seems rational to believe, however, that in the truer forms of chronic ulcer seen in the middle aged and old these conditions are of more moment as causes for the condition than in those of the second or third decade of life.

Emboli from heart lesions, etc., might cause the development of ulcers as they do infarcts in other organs (Virchow); a number of observers with various kinds of injections and methods (Orth, Panum, Cohnheim) have noted this to be true, providing the stoppage of circulation was confined to a limited area of the stomach. Localized thrombosis caused by internal injury may be offered in the same connection. However, embolic conditions are not common, and it is probable that, like sclerosis, embolism is more of a factor in those of

advanced age than in the young. Furthermore, it occurs to me that unless the emboli were infectious in nature, and thus capable of additional local destruction of tissue after lodgment, or large enough in size so as to cut off much circulation, the rich network of collateral circulation in the organ would protect the glandularis from the intima side. There is no doubt to me that syphilis is a cause of ulcer. This can be proven when Wassermann reactions are done generally in ulcer cases, and the results in the cure of ulcers by antisyphilitic remedies.

From as much as has been stated it is plausible to suppose that submucous hemorrhages and hemorrhagic erosions due to disease of the mucosa (chronic gastritis) or injuries to it exerted by agents interiorly applied and which cause local hemorrhagic or infiltrative results, or, on the other hand, the interference with local circulation and the subsequent digesting action of gastric juice on that area, such as may be produced by emboli, secondary infections or thrombi in chronic heart, liver and kidney disease or the acute infections, in individual instances, are causes for the production of gastric ulcer. It also seems reasonable to suppose that, although carried infections (such as may occur in appendicitis, cholecystitis, pyemia, syphilis, or tuberculosis) can cause gastric ulceration by secondary infections, and that, although bacterial invasion of the tissues of the ulcer base is commonly observed, this in the acute ulcers is usually a secondary infection from the internal side after the ulcer had been formed.

The recent brilliant findings of Rosenow with respect to the rôle of the streptococcus, based on a series of convincing experiments, seem to prove the infectious origin of gastroduodenal ulcers. Certain clinical facts, recognized for some time, have direct bearing on his conclusions. Chronic infection about the teeth, pyorrhea, or blind alveolar abscesses, chronically infected tonsils, or sinuses about the head, are invariably present in ulcer-bearing patients. Aggravation of symptoms in chronic duodenal ulcer occurs during the months when throat and other streptococcal infections are particularly prevalent. Improvement in symptoms has followed on the eradication of infectious foci, usually in or about the teeth, tonsils, and accessory nasal sinuses. Streptococci of a certain grade of virulence, quite irrespective of their original source, are prone to localize in the mucous membrane of the stomach and duodenum of animals following intravenous injection and produce ulcers which resemble those in man, as shown by Rosenow. The frequent coincidence of disease in the appendix, gall-bladder and duodenum or stomach is best explained on the basis of infection. Rosenow's researches, extending to this field in which all three lesions are simultaneously produced by streptococci of certain virulence and tissue affinity, seem conclusive in support

of the infectious origin of most ulcers. He has shown the almost constant occurrence of streptococci in the depths of human ulcers.

Bolton's experiments conducted to determine the factors which may convert an acute ulcer, whatever its cause, into a chronic ulcer, showed in a convincing way the rôle that delayed motility played in combination with the acid of the gastric juice, which acts both as an irritant and necrotic agent. Rosenow also infers that the localization of streptococci in the depths of ulcers and tissues about them is an important factor in preventing the healing of the ulcer.

The actual factors concerned in the production of pain in peptic ulcer has been made a subject of renewed investigation. This is of immediate importance inasmuch as epigastric distress or pain is the most constant symptom, and a rational understanding of the pain mechanism is essential to diagnosis and treatment. It has generally been taught and believed that the pain was due to direct irritation of the sensory nerve endings at the base of the ulcer by the free hydrochloric acid or by mechanical means through peristalsis. Thus the corrosion theory gained many adherents and fairly effective systems of therapeutics on the principle of the control of corrosion by frequent feeding and sufficient alkalinization, were the result. It is a fundamental clinical fact that the distress or pain of an uncomplicated gastric or duodenal ulcer bears a fairly definite relation to alimentation, being present presumably at the time of maximum free hydrochloric acid concentration in the stomach and being relieved by any measure which neutralizes or removes this offending hyperacid chyme. Thus the relation of acidity to pain seemed plausible and valid. On the other hand, clinicians and scientific investigators for reasons clinical, physiologic and experimental, too numerous to be detailed here, felt that there must be another primary factor in the mechanism of pain production which would adequately explain painful phenomena in the absence of hyperacidity, even in achylia, in extragastric conditions, etc. In this respect the work of Hertz in particular, Carlson, Cannon, Bolton, Kast and Meltzer, Ginsburg, Edelman, Duchese and others has seemed to prove quite conclusively that intragastric tension, the result of hypertonus, hyperperistalsis and pylorospasm, however produced, is the immediate cause of pain. In order to reconcile acidity and pain on the ultimate basis of tension, Hertz offers a solution by explaining that excessive acid chyme passed into the duodenum prevents relaxation of the pylorus. Of course the effect of this acidity will depend on the alkalinity of the duodenal juice. Thus hyperacidity may cause hyperperistalsis, prevent relaxation of the pylorus in a naturally hyperirritable stomach and intensified gastric tonus results. Pain is accompanied by contractions and pain

in gastric or duodenal ulcer is said not to be felt unless contractions are present.

Painful muscular contractions occur most frequently at the pyloric end of the stomach, and are due to an exaggeration of the normal reflex. The deeper layers of the gastric walls, especially the muscular layer, contain more afferent nerve fibers than the mucosa; hence, the ulcerated areas, when irritated, cause an exaggeration of the pyloric reflex, often with normal, and more frequently with hyperacid, secretion. As a result, the rise in intragastric pressure provokes pain. According to Hertz, the sensation produced by pylorospasm varies from a feeling of fullness to the typical hyperacidity pain relieved by milk, alkalies, etc. We have reason to believe that pylorospasm may cause very acute pain, simulating perforation. Especially in the presence of hyperacidity and hyperperistalsis, pylorospasm frequently occurs in disease of the gall-bladder and appendix, and this theory best explains the gastric disturbances or suggestive ulcer symptoms arising in disease of these organs. Pylorospasm has even been demonstrated roentgenographically by Cole to be due to reflexes from the terminal ileum and cecal region. Carman, in like manner, has frequently shown it to occur in gastric ulcers remote from the pylorus. The exaggeration of the pyloric reflex, which is regarded as the basis of late pains, may occur in cases of hyperacidity and hypersecretion with or without ulcer, and in so-called vagotonic persons having the combination of visceroptosis and hyperacidity with late pain and no ulcer.

Among other causes that have been advanced for the production of gastric ulceration are local anemia from arterial spasm either by itself or from muscular contraction of the gastric muscularis exerted upon the traversing arteries (Klebs); diminished alkalinity of the blood (Pavy, Jaksch); injuries to the nervous system, particularly the cerebrum (Brown-Séquard, Schiff, Ewald and others) or to the vagus (Talma, Yzerin) or to the celiac axis and splanchnics (Vedova); the most recently offered, the failure of the gastric epithelium to produce an antibody, "antipepsin," or the destruction of this by the hyperacid media, causing the loss of immunity from autodigestion (Wienland, MacCallum); and that of Friedman's in that a functional disturbance of the stomach exists due to endocrine imbalance.

#### PATHOLOGY.

An ulcer is a dissolution of surface tissue comprising in so far as the interior of the stomach is concerned all the distinct forms of ulcer, erosions (which are superficial ulcers), ruptured vessels (varix), and, if it is ever proven that these can exist, also fissures.

Distinct ulcers of the stomach may be funnel-shaped or crater-like and quite deep, or circular, oval, irregular, linear, or terraced and superficial in form. The acute ulcer is usually soft with slightly rounded edges, while those that have persisted for some time and been irritated may be quite stiff (particularly at the edges) from round-cell infiltration and hemorrhages and connective or scar tissue deposit (a form of chronic ulcer). The base is usually smooth, but may display uneven points due to the free ends of tissues or transverse muscle fibers of the inner muscular coat. The base is generally covered over with a greenish or brownish, tough mucus, and may be the lodgment site of a more or less tough blood-coagulum, which is torn away with some difficulty. The small superficial ulcers (erosions) often show no deposit on the surface, and, being the color of the mucosa, may escape detection unless carefully sought for with the aid of a magnifying glass.

The simple ulcers vary in size from 1 to 3 or 4 centimeters in diameter, some being much smaller and giving the gross appearance of ruptured follicles, and others again (particularly when several coalesce into one) are much larger, comprising great areas of the stomach mucosa. They are usually single, but often multiple, and may be found only in the stomach, first part of the duodenum, or lower end of the gullet, or in any two or in all of these organs in the same case. They are most often situated in the lowest parts of the stomach (standing position) in the pyloric and lesser curvature regions, are encountered less frequently as the fundus is reached, although no part of the organ is exempt. Statistics as to the most numerous sites of ulcers vary to such an extent that they serve to no definite purpose excepting in the way that all agree that the posterior wall and lesser curvature of the pyloric region make up about 65 per cent. of the instances, that those directly at the pylorus come next in frequency, and that of the frequency with which they are encountered in other locations, it may be expressed about in this order—anterior wall, cardia, fundus and greater curvature. Fenwick's statistics on the three zones give:—

	In 70 Chronic Ulcers.	In 39 Acute Cases.
Pyloric region .....	53	13
Middle zone .....	7	14
Near the cardia .....	10	12

Microscopically the margins of a fresh ulcer are usually clean cut with but very little inflammation or evidence of healing. The edge of the loss of tissue is usually abrupt through the entire depth of the glandularis with the submucosa or the circular muscular fibers as its

PLATE LXIII.



Photomicrograph of an acute gastric ulcer. *A*, The glandular layer or membrane showing the regular arrangement of a normal mucosa. *B*, Submucosa, much thickened, artery and veins. *C*, Muscular layer. *D*, Peritoneum. *E*, Edge of the ulcer showing partial destruction of the mucosa and a mass of granulative tissue below same. *F*, Part of the floor of the ulcer composed of disintegrating connective tissue. *G*, Mass of detritus that covers the pit of the ulcer to the other side.  $\times 35\frac{1}{2}$  diameters.



tissue base. Near the bottom of the edge there is generally a gentle depressing slope toward the center of the ulcer made up by deposit of mucus, detritus, bacteria, blood-cells, and molds which collect under the shelving edge. In the older ulcers there may be a reactive inflammation at the periphery with the formation of a calloused margin or even an irregular scar-tissue formation. The radiations of scar tissue may be marked at one edge, while another edge of the ulcer is free from them and soft and the ulcer margin abrupt. The gland cells at the edge of the ulcer (particularly in the cell nests of the fundus of the tubules) display cuboidal or cylindrical cells instead of the characteristic tubule elements. Such cells are also seen in the irregular crypts, vacuoles, or blind tubules that form in the scar tissue; these are considered by some observers to be neoplastic in nature and the primary elements in the development of subsequent cancer. For some distance from the ulcer the lab-cells have the appearance of hyaline degeneration and their nuclei cannot be recognized by staining. The submucosa and sometimes the edge of the glandularis is permeated with small round-cell infiltration and a strong vascular net; these are most probably the beginning of repair process leading to cicatrization.

Healing of small ulcers may occur without visible cicatrization, although in plainly visible ulcers scar tissue replaces the area left by the necrosis. The healing process commences at the sides and floor of the ulcer, at which the margins become more indefinite and irregular in outline. In slowly healing ulcers patches of indolent granulation are common and chronic inflammatory areas which lead to erosion and recurrent bleeding may be present. Such erosions may involve surrounding new points in the glandularis, causing opening of the large vessels, with severe and even fatal hemorrhage. Scars vary much in size and thus subsequent contractions may deform the organ, producing marked localized deformities, and when girdling, even an "hour-glass stomach" or giving a cucumber shape to the organ. They may also cause sacculation or a bridge-like formation, which, when situated in the pyloric region, may cause more or less stenosis with the development of stagnation of the food contents. If the necrosis is deep and rapid, the muscularis and peritoneum may be destroyed, perforation resulting. This is particularly liable to occur when enough time has not existed or there is no constant contact of that part of the stomach to surrounding structures for protective adhesions to form.

The twelve different forms in which ulcered conditions of the stomach are met with, each of which is different from the well-known acute ulcer described, were offered by the author in an article

under "The Recognition of Obscure Types of Gastric Ulcer" (Archives of Diagnosis, October, 1909), as follows:—

1. Small superficial and often multiple septic ulcerations of the pyloric region and duodenum.
2. Erosions or exfoliations, consisting of small flakes of the upper regions of the glandularis, conditions which have served as a cloak to the advancement of a newly discovered clinical entity, but which, nevertheless, were long ago better classed as "catarrh ulcers," and which are present mostly in chronic granular gastritis.
3. Fissures, generally of the pyloric region, and no doubt exceedingly uncommon.
4. Punctate ulcers, results of infection through the gastric tubule, a lymph follicle, or an acinous division of a mucous gland.
5. Small-sized peptic ulcers, single or multiple, gastric or duodenal or both at the same time, none of which pass through the inner stomach wall to the muscularis and thus all of which fail to give intense symptoms because the muscularis is not exposed to the gastric juice.
6. Ruptured varix from hepatic, cardiac or renal disease.
7. The chronic forms of ulcer, which begin as such, are usually single and duodenal or gastric, ulcers which pathologically are excessive deposits of connective tissue at and infiltration of small round cells in and beyond the ulcer area. To these ulcerative states must be added the pathological types of a sequelous nature occurring in cicatrices from the more or less acute ulcers. In autopsies and operations are displayed:
8. The large, flat stellate, and the long, thick cicatrices causing deformities of the stomach.
9. Separation of the glandularis from the edge of a linear scar due to motion and marginal ulceration.
10. The autodigestion of the center of a thick scar by the gastric juice, caused by the center area of the contracting scar being almost devoid of circulation and therefore easily overcome.
11. Perigastric adhesions and broad extent of local interstitial connective-tissue deposit, causing hour-glass stomach, tugs on the contour of the stomach, or pyloric stenoses.
12. Malignant degeneration of an old ulcer.

#### SYMPTOMS.

The symptoms of gastric ulcer vary so generally both in character and intensity (some even presenting no definite or suspicious symptoms at all, or the first and only symptom being a serious or fatal hemorrhage or those due to perforation), that it is impossible to delineate special symptoms or symptoms in class as characteristic of any one of the varieties of ulcer conditions that may be met with. To show how impossible this is, it may be said that, depending upon the size, shape, depth, number and site of the ulcers, the character

of the pathological process, complications and sequels, the age of the patient and the chemico-dynamic condition of the organ, the common clinical symptoms of pain, tenderness, gastralgia, vomiting, "dyspepsia," and the results from the gastric and fecal analysis vary markedly in each instance. However, in many of the cases of simple ulcer these are characteristic enough in grouping and intensity to make diagnosis possible, and these will be referred to as ulcers of the clinical type. In the instances that depart from this (that is, those in which pain, hematemesis, vomiting, excessive gastric juice secretion, gastralgia, etc., are masked or lacking) diagnosis requires most careful study and observation. And, lastly, in the minority of cases it may be said that diagnosis is impossible by medical and, in some instances, also by surgical means. As is proven by many autopsy statistics, the first discovery that ulcer of the stomach had or does exist is hardly less common than lesions of pulmonary tuberculosis or tuberculosis of the chest lymph-glands. According to Stoll, latent ulcer was found in 27 per cent. of 3476 autopsies, and Lebert reports that in 15 per cent. of 110 cases ulcer was present before severe symptoms arose manifesting its presence. When carefully searched for, small-sized depressed deposits of scar tissue of healed ulcers are frequently met with at autopsy.

Not considering the plain clinical type of acute ulcer, Ewald<sup>2</sup> divides the symptom-complex of stomach ulcers into the following groups:—

"1. Cases in which the irritative symptoms which result from hemorrhagic erosion or the corrosion of larger or smaller areas of mucous membrane predominate, and there are no complications. 2. Cases in which the previously mentioned irritative symptoms and hemorrhage simultaneously appear. 3. Cases with symptoms of irritation and perforation. 4. Cases which run a latent course up to the time of death from hemorrhage or perforation. 5. Cases which present the sequels of ulcer. When we remember merely the fact that in these groups the symptoms may be variously combined, an ever-changing clinical picture is presented."

**Pain.**—The pain in gastric ulcer is one of the most prominent symptoms. It is variously described as burning, boring, cutting, tearing, or a constant dull ache. As a part of ulcer syndrome it is present in 8 per cent., and in a general way in 91 per cent. of my cases. In each case the character of the pain changes, usually according to the ingestion of foods or drink or position in the ways that such may increase the severity or intensity of it. Therefore, over the course of hours it may be said to be paroxysmal—at one time dull, at another time excruciating.

This symptom is produced by the irritating effects of the stomach contents on the exposed nerves of the ulcerated surface, and also by the muscular contractions which arise in consequence of the irritation and normally. They occur during the period of gastric digestion either immediately after the taking of food or after saturation of food with hydrochloric acid has taken place and an excess of free acid is present. As a rule (although there are many exceptions), the nearer to the pylorus the ulcer is situated, the longer after ingestion is the onset of the pains, while in many of those of the pylorus and duodenum comes on three or four hours after the taking of food; this fact is of some value in diagnosing the seat of ulcer.

A case of acute ulcer of the anterior stomach wall described by the author in which posture as well as the character of food had a marked influence on the production of pain is worthy of note (Journal Amer. Med. Assoc., July 22, 1911) :—

Ulcers of the posterior wall and greater curvature of the stomach and duodenum in the region of the pylorus are most common, while those of the anterior wall all the way to the fundic region are distinctly uncommon—comprising possibly, not more than 10 per cent. of the areas with which gastric juice comes in contact in the process of gastric digestion. Ulcers in the latter location are rarely diagnosed medically, diagnosis usually taking place at operation for the perforation, a complication most likely to happen in these cases because of the unprotected state of the anterior area of the stomach. The rapid peritonitis consequent upon perforation of these ulcers also makes the diagnosis of them important, and a case is offered in which this was possible and in which the medical treatment was successful.

*Patient:* Miss E. McD., a stenographer, 18 years old, was first seen on Feb. 1, 1911. Her father died at the age of 45; cause unknown. The patient's mother was living and well. The patient had always been fond of sweets (mostly candy) and had indulged intemperately for several years, which at times brought on an acute distress in the stomach with a day or so of anorexia; other than this the patient had had no illness except measles and scarlet fever in early childhood. In December, 1910, she began to have a constant distress in the stomach, in which the symptoms of excessive gas collection with eructations and pain an hour after meals in the left side of the abdomen were the prominent features. This pain, which was most acute, was relieved to a moderate degree by the taking of food, more so by bicarbonate of soda, and was entirely relieved when the patient lay flat on her back with her corsets off. She stated that by taking milk, eggs and other simple foods in small quantities at a time, with the assistance of bicarbonate of soda, she was able to be about at her work. The solid foods she ate evenings and Sundays when she could lie down for three or four hours after taking them. According to her statement, she had lost only 4 pounds since the beginning of her illness.

*Physical Examination:* The patient's facial expression was that of intense suffering while sitting and changed to one of complete relief when lying. The lungs were normal, and the heart also, excepting a hemic blow over the body which was transmitted to the vessels of the neck. The skin and mucous membranes were abnormally pale. There was but slight development in the soft body tissues; the

PLATE LXIV.



A. Photograph of a clinic case of acute gastric ulcer showing the location of the direct pain (on pressure). It was found just below the ensiform and the area was about one inch in diameter.

B. Photograph of the same case showing the location of the reflex or indirect pain (on pressure). It was situated to the left of the spinous process of the twelfth dorsal vertebra.

C. Photograph of a private case of acute gastric ulcer showing the painful area lower down than above and to the left. (Miss L. K.)

D. Rear view of the same case showing the location of the indirect pain on the level with the ninth dorsal vertebra.



est and abdomen presented the type of a girl. On palpation the abdomen contracted, especially on the left side, and notably the left rectus muscle. A point of exquisite tenderness to pressure was evident about 2 inches above the umbilical line and just at the edge of the rectus. Careful palpation of the abdomen with the knees raised toward the thorax disclosed a mass, thin and soft



Fig. 112.—Showing the patient and the location of the subjective pain, point of tenderness on pressure, and the plastic exudate. There was no referred pain or tenderness in the back.

touch, at the exact site of the tenderness, which I am led to believe was a plastic exudate on the gastric peritoneum over the ulcer. The stomach was low situated, and gases could be heard passing through the pylorus. The right kidney was palpable to within an inch of the upper pole under deep inspiration. The stool (simple) taken the next morning showed a return of 120 c.c., free hydrochloric acid, 55; combined hydrochloric acid, 28, and total acidity, 87. A small

amount of macroscopic blood was present with one small clot. The feces voided the day before and two days afterward showed the presence of occult blood. Three X-ray plates were then taken. Each showed that the stomach had discharged the greater portion of the ounce of bismuth given into the small intestine (hypermotility), that the organ was large and low (dilatation and prolapse), and that the ulcer-bed was lined with bismuth. When the X-ray plates were held against the patient's body, and the ensiform and umbilical markers on the plates matched to these parts on her body, the location of the ulcer noted on the plate corresponded exactly to the point of tenderness and the plastic exudate.

*Course of Disease:* The next morning when the patient went into the hospital, the blood showed erythrocytes 3,700,000, morphology normal, hemoglobin 67 per cent (Dare), color index 0.6, leucocytes 8290, and differential count normal. Kept steadily in bed for three weeks, she was fed by the Lenhardt method, the feedings of milk being given at stated times and amounts during the day and night. The administration of finely comminuted foods was begun late in the third week. The stomach was maintained alkaline by a mixture of alkaline powders, without soda bicarbonate, this being given at three-hour intervals. The bowels were moved each day by a castile soap enema (not saline, because this increases the hydrochloric acidity in the stomach). Liquor ferri albuminatis in 2-dram quantities in water *t. i. d.* was used to combat the anemia, and an ice-bag was employed during the first days to decrease the tenderness at the ulcer site, although this was hardly necessary, as the patient was on her back all of the time. She made a perfect recovery, and when she left her bed there was no spasm of the left rectus, no tenderness on pressure over the ulcer site, and no plastic exudate. The blood had come up to 4,100,000 erythrocytes, 87 per cent, and color index 0.85. She was then fitted with a corset which raised the pyloric region over four inches; her feeding was increased to the taking of more solid foods, the alkaline powder kept up, the iron tonic diminished to half quantity each day, and Carlsbad salts used to move the bowels. She went into the hospital weighing 98 pounds, and now at the end of two months thereafter weighs 127 pounds, and is without a symptom of digestive distress. The X-ray plates of today do not show the ulcer; the stomach is smaller in capacity, hypermotility is no longer a feature, the test-meals are normal, and the feces free from blood.

Early in the affection before marked gastralgia is present, the pain is localized in a small circumscribed area mostly in the pit of the stomach and near to the median line. At other times, it is nearer to the costal edge on the left side. During the paroxysm the pain may extend anteroposteriorly and may even radiate up the back and chest. Vomiting and retching usually increase the pain. The distress is usually made worse by the taking of coarse foods or irritating drinks, and usually increases on pressure; although with some, a firm gentle pressure affords some relief. Distention of the stomach with food, fluid, or gas and pylorospasm also increase its intensity. Too hot ingestum usually stimulate extra movement and secretion, and thus often increase the intensity of the pains or bring on acute paroxysms.

In 83 per cent. the pain or distress had definite relation to food ingestion. It was found that in more than 3 out of 4 cases of pain that

it occurred within four hours following the taking of food. In uncomplicated ulcers, pain usually came on sooner after a light meal than after a large one, *i.e.*, relief by food intake was not so long maintained. Irrespective of the location of the ulcer it was shown that nearly 80 per cent. of instances have distress within four hours after eating, nearly 50 per cent. have discomfort within three hours after food; more than 44 per cent. of lesser curve ulcers have pain one to three hours *post cibo*; nearly two-thirds of the ulcers located near the cardia have maximum distress within two hours following food intake, and two out of five within one hour afterwards.

Except in the acute accidents of the disease or when pyloric obstruction or "hour-glass" contraction has occurred, distress in gastric ulcer is most commonly relieved by limitation of the amount or alteration in the character of ingested food (diet), the taking of food when distress is most marked (food-ease), the neutralization of acid by alkalies or by emptying the stomach (vomiting, lavage). As has already been mentioned, opiates are not infrequently required.

The observation of relief of gastric distress by food ingestion is of prime importance in diagnosis of uncomplicated peptic ulcer. If its history is constantly obtained, it is practically pathognomonic in three out of five cases. While patients, on casual questioning, frequently state that food distresses them, yet careful inquiry will elicit the fact that food does not at once cause discomfort, but that such comes on from one to four hours following ingestion. If the gastric lumen is not obstructed (hour-glass contraction) or if the pyloric channel remains patent, our observation is that the duration of food relief of pain bears direct proportion to the size and character of the meal taken. Small amounts of food give relief for a shorter period than do large, and liquid food relief is not infrequently more prompt than that obtained by solids. The dread of pain following food intake often leads to an anticipatory attitude on the part of the patient. This state of mind appears to exert a not altogether negligible influence in the production of uncomfortable gastric spasms. That this is so is readily shown by the change occurring in pain time and pain intensity following the administration of atropine or bromides. A game of golf, cards, or foot-ball very often brings about similar beneficial effects.

If there be hyperacidity, the taking of highly albuminous foods of a fluid character (milk, eggs) often relieves the gastralgia. The anterior area of pain or point of tenderness on pressure is generally constantly present in the same place. In acute cases this area should be noted by proper marking and should not again be pressed upon during the course of the healing (irritation to the ulcer and danger of

hemorrhage). In subacute or older cases this precaution need not be observed. The pressure to learn the tender area should be made with the tip of one finger and not be greater in force than for arriving at a definite conclusion.

Two spots of tenderness commonly exist in the cases of simple ulcer of the clinical type, (1) epigastric and (2) dorsal. Considering the clinical types of ulcer, the epigastric pain occurs in about 80 per cent. of all instances; both together in about 30 per cent.; the dorsal alone in rare instances. Boas, who first drew attention to the indirect pain, describes this as "localized and more circumscribed than the epigastric, and generally located at the level of the tenth to the twelfth dorsal vertebra alongside of the vertebra in a lateral expansion of two or three centimeters and a length of one to four centimeters." This pain is usually elucidated on deep point pressure to the left of the spine and on a line with the spinous processes of the vertebrae. A like tender area may be noted to the right, in which case only the duodenum may be affected, or when the ulcer is in the stomach, the right and left sides are painful on pressure, but the left to a greater extent. In so far as the single objective symptom of spinal tenderness on pressure is concerned, we should not depend upon the presence of it to make a diagnosis or to conclude results of therapy. The largest proportion of cases of ulcer do not present them, and even if the healing has been incomplete do not develop them subsequently. As a clinical sign their only value is as a suggestion to the diagnosis in the first or second examination—that is all. I have never been able to prove that these back pressure points were increased in intensity when the epigastric pain was marked. It has been assumed that they are referred to the posterior spinal nerves from some of the terminations of the corresponding anterior nerves that are involved in the ulceration. In my opinion, they are more probably due to a hyperalgesia imparted to the anterior branch close to the vertebral column by the sympathetic nerves from a lymphangitis about the celiac axis, or to adhesions or irritability of the peritoneum caused by the affected area (in this sense they may be considered as direct). My reasons for this contention are: 1. That the anterior branches of the intercostal nerves are not tender or sensitive to pressure in their course. 2. That pain, subjective and objective, corresponding to the area of distribution of the terminal fibers is practically never observed; the tenth supplies the skin at the umbilicus, the eleventh and twelfth the skin below this—does the pain exist or is there ever spasm only in the lower section of the abdomen? The first usually occurs in the epigastrium, and the upper rectus spasm is not constant and only takes place when pressure

is made over the ulcer area. 3. That the degree of pain occurrence increases through the coats of the stomach from *nil* in the glandularis to intense in the peritoneum, and there most probably is no direct distribution of cerebrospinal nerves in the peritoneum. 4. That the pain is most probably referred by way of the communicating links from the great sympathetic plexuses (solar) which are intimately connected with the anterior branches of last dorsals at the back of the abdominal cavity; a clinical proof of this is the presence of the rather general longitudinal tenderness over the dorsal spine in the sensory gastric neuroses and gastralgia, and even in quite a number of cases of acute gastric ulcer. In my experience, the pressure pains at the back in ulcer may be met with at any vertebral level even as high as the sixth dorsal, although they are liable to be less common or exist to a less degree as you ascend above the tenth or twelfth dorsal. These spinal areas of tenderness are more common in women than men. The local sensitive spinal areas in neurasthenia should not be mistaken for them. Tenderness on pressure is found in about 65 per cent. of cases, and rigidity in about 60 per cent.

**Vomiting.**—With few exceptions in so far as gastric disorders are concerned, vomiting is a symptom of importance in all serious stomach affections. Of course, like any other single symptom and even in the most severe gastric affections, it may not be present or a marked feature in the history, but when it is, its occurrence should always receive full consideration. In ulcer, statistics vary in the percentage of instances that it is met with; an average figure shows this symptom to be next in frequency to pain, being present in about 70 per cent. of a large number of cases. It usually occurs with pain, although vomiting, nausea and eructations may occur when no actual pain is present, or when only those of indefinite gastric distress exist (weight, fullness, pressure, dragging, etc.). Vomiting may be constant, occurring whenever foods or drink are taken, or it may take place only at intervals of several days or more. It may occur immediately following meals, or two or three hours afterward at the time when the mechanical or chemical irritation of the contents brings on ejection, and in these instances it is usually preceded by epigastric pain, which is relieved when the organ is sufficiently emptied. To some extent, the onset of vomiting depends also upon the quantity of food and does not occur when a small amount has been taken. In recent ulcers the food returns apparently as it was taken, but on close examination it will be seen to be more or less digested according to the status of gastric secretion and length of stay in the stomach. When pyloric stenosis is present the contents may display evidences of retention.

The latter is not seen when only primary atony exists. The vomitus is usually acid, and when occurring somewhat incessantly it may consist practically of gastric juice mixed with blood and mucus; at these times the quantity ejected at each vomiting spell is small.

**Hematemesis.**—Blood is frequently present in the vomitus, and occurs in plainly macroscopical amounts in about 30 per cent. of the cases, and when noted by means of blood tests of the gastric contents or feces in about 45 per cent. of all cases, and is more common in duodenal than gastric ulcer. It is well to recall that there are other causes of hematemesis (swallowed blood, gastric hemorrhage when no ulcerations can be noted, varix; congestions from cardiac, pulmonary, or hepatic disease; the blood dyscrasias, etc.). On the other hand, more general utilization of the blood tests (occult blood) in examining gastric contents and feces will show a greater percentage of bleeding from ulcers than would be noted from only the macroscopic observations. Especially is this true when ulcer cases are observed over an extended time and when complications and unfavorable sequels exist.

The blood is usually arterial, the vessel becoming eroded during the development of the ulcer, and the hemorrhage may be serious and even fatal. In other instances the bleeding is more of an oozing from small vessels, is slight in amount, and may be observed as reddish-brown streaks in the vomitus, or only by the blood tests, and perhaps those performed with the feces. When much hemorrhage exists, the vomitus is characteristic according to the amount of blood and its degree of alteration. The feces at these times are reddish, dark brown or black, and with a shiny surface. Marked degrees of hemorrhage may also come from veins, or even the pore-like erosions referred to by Dieulafoy as "exulceratio simplex." Large amounts of blood in the stomach act like an emetic. In this event there may be no premonitory symptoms and the condition is not recognized until the vomiting occurs, after which the general symptoms of weakness, dizziness, rapid pulse, pallor, sighing, and demand for more air to breathe and water to drink develop (collapse more or less complete). If the quantity of blood be moderate or small in extent, neither the vomiting nor the general symptoms of hemorrhage may be observed. In these instances the blood passes into the intestines and may be found by the examination of the feces, particularly by the chemical tests. The hemorrhage in acute ulcer is usually intermittent and large in amount, while that from the sequels and chronic ulcer is more constant and small in amount; still, in diagnosis, this is not a safe rule to follow, since acute ulcers may not have any appreciable hemorrhage and chronic ulcers a copious and repeated bleeding. In suspected ulcer it

is always desirable to examine the stools for blood after the severe attacks of pain.

In most instances the younger the patient, the less the danger of death from bleeding, although in persons under thirty years the bleeding can be so large in amount or continuous that they are overwhelmed. Slight hemorrhages usually have no serious influence upon the condition of the patient. Moderate amounts lead to extreme anemia and its consequences. Death from hemorrhages is usually due to rupture of the ulcer, and corrosion of the splenic, gastric, or pancreatic artery or their veins, the portal vein, or the left coronary artery when the ulcer is situated in the lesser curvature near the cardia. Ulcers in any part of the stomach may cause fatal bleeding; those in the duodenum are not so liable to be the cause of profuse hemorrhage or hematemesis, although they bleed more steadily than do the chronic ulcers of the stomach found elsewhere.

The noting of the presence of small amounts of blood (occult) in the gastric contents and feces is of value in the diagnostic, prognostic and therapeutic aspect. In the diagnostic sense, it usually means organic lesions of the gastric mucosa and duodenum, and among these may be mentioned ulcer, erosions, cancer, hemorrhagic and phlegmonous gastritis; secondary gastritis from heart, lung, liver, and spleen disease; portal thrombosis, the infectious fevers, and amyloid degeneration of the gastro-intestinal vessels and organs. Some of the systemic conditions in which it may be found are hemophilia, purpura, arteriosclerosis and tabes with gastric crises. Blood may be present in the feces in malignant and benign tumors of the gastro-intestinal tract; in the malignant and inflammatory conditions of the pancreas, liver, and gall-passages; in tubercular, syphilitic, or simple catarrhal ulcerations of the bowel, and the rectal conditions (hemorrhoids, fistula and fissure). The intermittent presence of occult hemorrhages suggests gastric or duodenal ulcer, whereas the constant presence is significant of carcinoma. In ulcer when treatment has been instituted it usually disappears; in cancer it is constant. In advanced cancer cases the presence of blood is noted in the gastric contents in about 95 per cent. and in feces in about 80 per cent. of cases; in ulcer its presence is noted in the feces in about 45 per cent. of cases. In the uncomplicated neurotic or catarrhal condition of the stomach it is not found excepting from trauma from the stomach-tube—the feces examinations are always negative. During the cure of ulcer and afterward, the subsidence and failure to obtain positive blood-test results in the gastric contents and feces are, in the absence of other symptoms, of good omen. If blood continues or recurs it usually means incomplete cure of the ulcer, complications or

sequels, or carcinoma. Before making the tests for incorporated blood in feces, the lower bowel should be emptied by enema or otherwise, a small amount of carmine or charcoal given by mouth, following which all foods are allowed excepting those of meat and fresh fish (I do not agree with Martin that this extreme care is always unnecessary). By continuing the diet, and after the demarkation is noted in the stools, the feces are examined on the three successive days for blood, taking three portions of the feces in each instance (the lower end, the middle, and the soft end, or if the feces is mushy only one portion). The noting of the reaction at a single instance is a positive result; if it is not noted during the three days it is negative. In the diagnosis of ulcer the test is of value when positive, and does not argue strongly against ulcer when negative.

Hemorrhage occurs in both gastric and duodenal ulcers with about the same degree of frequency and danger, but in the stomach it may be gastrototoxic in origin. So true is this that the large majority of severe hemorrhages from the stomach which are not preceded or followed by the ordinary signs and symptoms of ulcer are not due to ulcer but to gastrototoxic or varicose conditions, the result of some type of gastrointestinal or hepatic poisoning, and disease.

**General Symptoms.**—The general condition of the patient, as a rule, remains good, although anemia, weakness and emaciation due to local causes in the stomach are common and sometimes marked, particularly when the ulcer has existed for some time. The symptoms of pyrosis and regurgitation of acid fluid and gas from the stomach are usually present in the latent cases. The appetite remains good, but the patients fear to eat because of the pain. In the complications and chronic ulcer there may be distinct anorexia. Nervousness ensues from the constant pain and subnutrition. Absence of fever is the rule, but a rise of about 1° F. may occur, particularly when peritonitis, adhesions, perigastritis, or hemorrhage exist. Thirst is common, and constipation is the rule. Nausea and a sense of faintness are present in a large number of cases.

The blood usually shows a decreased red blood-cell and hemoglobin content and a slight leucocytosis; particularly is this true after hemorrhage has occurred. The blood changes are those of a secondary anemia, and should be considered both as a result and cause of ulcer. As was mentioned before, in the healing of the ulcer specific attention to the anemia is often necessary for the healing of the lesion.

When vomiting or profuse bleeding occurs the urine is lessened in quantity. Its acidity is usually lower than normal, and may even be neutral. In chronic ulcer when gastric stagnation exists the urine

may contain a high ethereal sulphate percentage and indican. The albumoses may be present, and albumin is a common finding in ulcer of middle life or the aged.

**Objective Signs.**—The front and back tenderness has been mentioned. A general tenderness over the stomach region in the abdomen may be present, particularly when marked gastralgia exists. A sharply localized tender area at or near the median line (left or right) is suggestive of the site of ulcer being in the pyloric region; if distinctly to the right and there is no diffuse tenderness over other stomach areas and the back pains are absent or at the right of the vertebra, it suggests ulcer of the duodenum. In so far as the stomach proper is concerned, too much dependence as to the site of the ulcer must not be placed on the location of the tender area (unless this is confirmed by the X-ray); in diagnosing duodenal ulcers the latter is of no value. Point tenderness more to the right and higher (biliary area) is more suggestive of gall-bladder affections. No tumor is palpable in fresh ulcer, but a small one may be formed and be palpable after scarring or when hyperplastic deposit on the peritoneum is present. In recent ulcers the degree of tenderness is often so great that resisting spasm of the upper recti is observed during the course of examination.

Of primary importance in the routine examination is the detection of muscle-spasm or resistance, tender point, mass, succussion splash, visible peristalsis, and percussion boundaries of the stomach. A rigid rectus is indicative of an inflammatory or perforative process. Tender point in uncomplicated ulcer, except during some instances of acute exacerbation, is usually absent. There is more or less epigastric sensitivity in all cases having gastric disturbances irrespective of the cause, so that especial care is necessary in making a proper interpretation. However, a definite localized and fairly constant tender point, often corresponding to the pain area, has diagnostic significance. Chronic and subacute perforating ulcers are invariably sensitive to pressure. Ninety-five per cent. of all epigastric tumors or masses in association with intrinsic gastric symptoms are malignant; the remainder are the result usually of an inflammatory process. A small, non-sensitive, movable mass having a tendency to disappear and reappear, is characteristic of a palpable pylorus. Peristaltic unrest of the stomach signifies obstruction and is always looked for when evidence of retention is at hand. This sign may often be brought out by careful kneading of the abdomen or by gaseous distention (sodium bicarbonate and tartaric acid). In the large majority of cases the physical examination of the abdomen in benign lesions is of least diagnostic value owing to the usual absence of these signs.

**X-rays.**—The combination of roentgenoscope and roentgenograms, when indicated, marks the most recent important and far-reaching advance in the diagnosis of gastro-intestinal lesions. In the hands of competent, experienced roentgenologists this method is sharing honors with the usual clinical diagnostic methods. In their enthusiasm some roentgenologists would do away with all other methods—an attitude both unscientific and harmful in its influence on the profession. If in some instances roentgenologic examinations have usurped usual clinical methods, it was not because the latter were at fault, but because they were not sufficiently employed. Speaking from the standpoint of the internist, the roentgen method has the following particular advantages:—

The screen gives accurate information regarding form, tonus, peristalsis, size and position of the organ. The roentgenologic bariumized carbohydrate double-meal method is a most sensitive test for gastric motility, since it shows delay of evacuation beyond six hours and yields information as to hypermotile conditions. The cardinal and most dependable roentgenologic sign of gastric or duodenal ulcer is a defect in the contour of the luminal outlines, expressed in terms of niche, accessory pocket (in gastric lesions), or deformity of the duodenal cap. This could be demonstrated conservatively by my associates in studies of large series in an increasingly high percentage of cases. This method affords the only reliable means of localizing the lesion. Although the clinical history and the results of physical and chemical examination invariably justify an unreserved diagnosis of ulcer, they do not indicate with any certainty whether such ulcer is gastric or duodenal. Graham has recently contributed to the literature, an exhaustive study bearing on the differential clinical characteristics of both types. He concludes that no symptom or group of symptoms can more than suggest location, and often, as the histories show, the gastric case may have the pure duodenal syndrome, and the duodenal case may quite as clearly give the gastric type of symptoms. The roentgenogram best reveals unexpected instances of multiple ulcers, hour-glass deformity and other abnormalities, including organic gastric syphilis. The roentgen method has its most unfailing application in the recognition of gastric cancer, and in the frequent detection of gastric ulcer undergoing malignant change. Besides, it usually gives an index not only as to location in such cases, but also as to type, extent and operability. Negative roentgen findings in cancer suspects are most convincing evidence of the absence of disease.

While obviously the roentgen examination is essential it should not be undertaken until a careful history has been taken and the complete

physical and laboratory examination made; it should not be resorted to as a first aid nor should it be contrasted with the clinical evidence for it is a part of the clinical examination. Otherwise erroneous conclusions may be drawn. Daily experience attests the value of the combined procedure in establishing within a brief period the proper diagnosis in all but a negligible few cases.

A number of the cases in which the Handeck niche is plain on X-ray plates are not cases of ulcer. If you examine stomachs on a fluoroscopic screen, what looks distinctly like a niche if it happened to be taken on a plate at the time would warrant the diagnosis of gastric ulcer, yet at operation no gastric ulcer is present. Then again many cases of gastric ulcer I have seen do not show any niche. It is true that cases in which the niche has been displayed and which have been put to bed on the basis of ulcer, after a few months' time do not show this peculiar bulge in the peristalsis. That does not prove that an ulcer has been cured. Clinical symptoms of ulcer are necessary to be present, to warrant the diagnosis.

**Gastric Analysis.**—Quite naturally this varies according to the type of ulcer, and the site, extent and condition of sequelae. In the clinical type of acute ulcer when the characteristic symptoms of acute onset of pain, vomiting and hematemesis are present, gastric analyses are not necessary for diagnosis; the clinical observance of the patient and a test of the vomitus for acidity and blood are usually all that are required. When the symptoms are not pronounced and particularly if there is a suspicion of ulcer being present, the stomach-tube may be used for diagnostic purposes. For many years (because of the danger of perforation by the tube or from the straining and retching its passage causes) the controversy has waged as to whether a tube should ever be passed in distinct ulcer cases or even in the suspicious ones. Personally, I fully agree with Ewald that it should, and that no danger can come if sufficient care is taken and it is manipulated by experienced hands. Logically, some modifications to the usual procedure of extracting test-meals in the way of obviating prolonged straining should be observed, and for this reason the aspiration method is distinctly preferable to that of simple extraction. In obtaining the stomach contents quickly and in sufficient amounts for complete analysis, the author's test-meal bottle method is particularly to be recommended, since by its use a steady and gentle suction upon the stomach contents is safely and quickly produced (page 154). In these cases one should always be satisfied to obtain between 20 and 40 cubic centimeters of contents, since those amounts are usually enough for the performing of the chemical, quantitative and qualitative tests and get a fair idea of the motility of the organ. Of course, this manip-

ulation is not to be undertaken during or immediately after a profuse hemorrhage, and it is often of additional safety to do the extraction with the patient in the prone position and on the left side. The tube should not be introduced too far, but just to the level that the return begins, which, in the left-sided prone position, is when the tip of the tube is in the fundic end and before it has coursed a length of the greater curvature. Particularly are these examinations called for in instances of the so-called latent ulcer, in the presence of complications (excepting profuse hemorrhage and perforation), and the sequels.

The objective point for diagnosis is the presence of motor delay or obstruction and incorporated blood in the test-meal noted in many cases of ulcer in which vomiting, hematemesis, or distinct pain is absent, and not primarily the status of gastric-juice secretion. In the absence of macroscopic evidences of blood the chemical tests for its presence should always be performed; the latter are more to be depended upon than the use of the microscope or spectroscope, although the latter means are conclusive when positive, which is not as often as the chemical tests. More or less delay in the emptying of the stomach is found in 65 per cent. of gastric ulcer.

In the event of the stomach being emptied by the extraction, the usual findings are a low amount of return (due to the hypermotility that generally exists with acute ulcer), and a variable acidity to the contents. Too much dependence, however, should not be placed upon an absence of suggestive findings, because acute ulcer cases are encountered in which the return is high and the acidity low or absent. In the acute ulcer the acidity is usually high, while in the subacute and chronic it is more often normal than high, low or absent. It depends mostly upon the condition of motility as to the combination seen. With a low return and hyperacidity (hypermotility) the findings pair in significance with a high return and a low acidity (hypomotility from primary atony or that due to obstruction). For, manifestly, the same amount of gastric-juice secretion may exist in both instances, excepting that the degree of dilutions is different.

When diagnosing the existence of ulcer the degree of acidity is of less significance in the suggestive manner than that of a history or a diagnosis of the existence of a hyperacidity prior to its occurrence. The controversy still wages on hyperacidity being a symptom of ulcer. In my opinion, it is only so in the causative way already suggested, and is of no value in that of an ulcer causing irritation to the stomach mucosa and thus a higher status of gastric-juice secretion. In ulcer, I believe that should the gastric juice show a high acid content in a measured quantity this is brought about by the irritation of the

muscular base of the ulcer causing a general hypermotility; and this means condensation of the acid secretions (possibly inflammation of the peritoneum, fresh adhesions, etc., could also bring about the same result). And thus, because only in the minority of acute ulcers is the muscularis freely exposed and the above-mentioned complications not met with, no strong dependence should be placed upon the symptom. For if there was, considering that states of excess gastric-juice secretions are so common (hyperchlorhydria, gastrosuccorrhea), why is it that a normal acidity is met with in 56.8 per cent. of gastric ulcers and a subacidity in 9 per cent.? (Ewald's figures taken). Köhler's statistics are even more significant in this direction, although it is probable that the figures of this observer included cases of carcinomatous degeneration. Therefore it is that we must not be guided in utilizing these chemical findings. A hypersecretion may exist without ulcer being present, and a simple ulcer itself cannot stimulate a higher secretion. There is, however, more clinical importance in the connection that in ulcer a continued subacidity or an acidity with lactic acid and blood should make one consider the presence of malignancy.

Particularly in the cases of gastric ulcer difficult to diagnose (latent), much valuable information may be gained from the fermentation of neutralized test-meals. In simple hyperacidities the bacterial content is low and the gas results are usually *nil* (always under 2 per cent.). In ulcer, even in the face of condensation of the normal acid, this result is often increased and may run as high as 14 per cent. This is due to the bacterial increase that usually accompanies gastric ulcer. In the presence of sufficient acid, I look upon 2 per cent. and over of gas as suspicious, and this, in my opinion, forms a most practical clinical method of diagnosis for those conditions difficult to recognize, numerous and important. In sixty-seven instances of the plainly clinical type of ulcer I found a gas present in nearly all, the gas content ranging from 2 to 14 per cent., with 3.7 per cent. as the mean average. In instances in which there are no suggestive symptoms of ulcer and the ordinary methods of gastric analysis lead strongly to the diagnosis of persistent hyperchlorhydria or gastrosuccorrhea, a gas content of 2 per cent. or over adds suspicion of a recent or old ulcer being present.

Soupault operated upon 28 cases of typical gastrosuccorrhea and in each instance found an ulcer at the pylorus. In 48 cases of gastrosuccorrhea Mathieu and Taboulais found hematemesis or melena 6 times, and 11 times very severe pains were referred to spasm of the pylorus. I agree fully with Ewald that gastrosuccorrhea, or hypersecretion, formerly regarded as a true neurosis, is not always to be regarded as a consequence of ulcer running a latent course. In separating the simple dietetic from

the ulcer cases much depends upon the number of analyses of gastric contents in each patient that are made for the purpose of noting—is it a gastosuccorrhea that improves sufficiently under therapy, or does it continue in spite of medical measures? The great majority of those that continue giving an excessive secretion are ulcer cases and are surgical in nature, and, as was stated, in diagnosing these the amount of gas produced is the most valuable measure of clinical diagnosis. The Gluzinski test is described in connection with carcinoma; it often serves to good purpose in ulcer cases. Finally it should be always kept in mind that gastric and even duodenal, ulcer may exist with achlorhydria.

In hypoacidity and hypomotility when the volatile acids are a prominent feature in the test-meals (chronic gastritis), in the low infective states, in the acute inflammatory conditions, and occasionally in the sensory forms of gastric neuroses, the gas content is sometimes over 2 per cent., but in these the hydrochloric acid content is low, and that is the distinguishing feature in separating them from ulcer and pyloric stenosis. In primary malignant disease this decreased or absent HCl, together with the other findings (lactic acid, Boas-Oppler bacilli, more frequent finding of blood), and because of the carbohydrate fermentation and proteid decomposition from stagnation, whereby the gas content is highest, usually over 10 per cent., and found in one of my cases to be 56 per cent., are sufficient grounds upon which to base a diagnosis.

I firmly believe that, when more perfect attention is paid to the matter of gas content and the bacteriology, more than one ulcer case out of four or five can be diagnosed by medical means. The Ewald simple test-meals, or the fluid vomitus from cases that have uncontrollable vomiting, are used in the estimations; the test-meals which remained the usual length of time in the stomach before extraction answer the best for diagnosis. The ordinary fermentation tube apparatus may be used, although the author's form answers better for the observations. The description of the technique of these examinations will be found elsewhere.

**Perforation.**—Perforation with copious hemorrhage comprises the most serious complication of ulcer. It occurs early or late in about 5 per cent. of all ulcer cases; statistics on hand from various sources claim from 3.2 per cent. to 22 per cent. The gastric form is more often seen in women than in men, simply because ulcer is more common in the former, although the duodenal form is more common in men. The reasons it is not oftener met with are because the muscularis of the stomach offers a greater resistance to the necrotic process than does the softer structures of the organ, and because the latter-day advances in diagnosing and treating ulcer have materially lessened the

PLATE LXV.



Acute perforating ulcer. At the margin the ulcer presents the typical round, indented-out appearance of an acute ulcer. Beyond the ulcer is seen an irregular formation of inflammatory thickening due to infiltration in the glandularis and a little exudate in the submucosa. This is no doubt the beginning of repair or tissue formation, and it is seen surrounding most acute ulcers after they have existed for some days. Otherwise the stomach presented quite a normal appearance, excepting that in places here and there were areas denuded of columnar cells.



moored in its upper part to the bodies of the vertebra, is comparatively small in size, deeply set, and more protected by adjacent structures.

According to the clinical course, Moynihan has classified the cases of perforation into acute, subacute and chronic.

In the acute cases, the onset is sudden, a free entrance into the peritoneal cavity takes place and the symptoms are severe and general from the beginning. Of some value at times are those due to gas and fluid in the free peritoneal cavity. The gas may pass between the liver and diaphragm which can be shown by X-ray or obliteration of liver dullness. Sometimes change of position will cause fluid to flow to a dependent part and air to rise to the top, which will cause dullness or tympany over the liver according to the position of the patient. With patient on the left side the front liver percussion may be tympanitic, whereas with patient lying slightly on the right side liver dullness may be continued into the flank caused by the gravitation of fluid, the air passing to the top.

The subacute cases are those in which the onset is not so sudden or severe. These occur when the opening is small in size, the stomach at the time empty of food, localizing adhesions have occurred, or the omentum blocks the distribution. These are the instances in which localized peritonitis or abscess formation have first occurred, after which the inflammation becomes more general. Such instances are liable to give the symptoms of increased pain rather sharply localized, a moderate fever, and suggestive white blood-cell count. Among these cases are those of the anterior wall perforation in which the onset of a general peritonitis is held back for a short time by the transverse colon and mesocolon acting as a barrier to infection to the lower part of the great peritoneal cavity.

The chronic cases are those in which protective adhesions have first been formed, and the symptoms are ephemeral or those of abscess. A localized peritonitis may last for some time which may become general. Extensive adhesions in the abdomen are common, especially with the liver, pancreas, colon, small intestine and omentum. The peritonitis and abscess are located in the upper abdomen and may be between the coils of the intestine, or be posterior and the lesser peritoneal cavity involved, the infection from which subsequently breaks through the foramen of Winslow and becomes general.

Lastly may be mentioned the fact that, in a minority of instances of ulcer, perforation may occur very late. Among the conditions of more or less healed ulcer in which such can ensue may be mentioned autodigestion of the central areas of a long-standing , the gradual attrition of some of the soft forms of latent or chro ,

marginal erosions and ulcerations at the edge of an old scar, and perforation occurring during the course of malignant degeneration. The latter are rare because of the extent of perigastric adhesions and connective-tissue deposit generally present in malignant degeneration.

The symptoms and signs of perforation vary according to the conditions present. It may be said that there are no pathognomonic symptoms of perforation, although the severe acute cases are often easy enough to diagnose. In these the onset is usually sudden, and the pain and tenderness spontaneous and referred to the site of perforation. In a short time the pain spreads across the upper abdominal area, although its original site is usually at the center of greatest tenderness. Deep breathing causes pain, and the case may be mistaken for a pleurisy particularly of the diaphragmatic type. At first the abdomen is flat, tense and immobile, and patients assume the position that gives the most ease and complain upon being moved into another position. Later on the abdomen distends but still remains rigid and immobile. This latter combination is most significant, for in intestinal distentions due to other causes (such as is seen in severe septic pneumonia) the abdomen is tense but still soft (balloonlike). The movements which affect the viscera of the upper abdomen (breathing, coughing, vomiting, retching, etc.) increase the pain, while those which affect the lower part (micturition) are not so painful or cause no pain at all. The liver dullness is absent in one-fourth of the cases, diminished in one-half, and not affected in the other fourth (this depends upon whether general peritonitis is present and to what extent). A friction rub may be heard over the diaphragm and the gurgling of fluid through the perforation are symptoms possible to obtain in a few cases.

Because of the rigidity of the abdominal muscles, percussion of the stomach area in the way of noting diminution of the size of the organ is not possible, nor is it advisable. Collapse and prostration soon supervene. The pulse is usually accelerated, but may be as low as thirty to the minute in the early stage; for a short time early in the case it may be normal. The temperature is not altered at first, but soon raises or becomes subnormal, depending upon the rapidity and extent of collapse; as a rule, the rise in temperature is not higher than 39° C. (102° F.). The slower the onset of symptoms of general peritonitis, the higher is the temperature run; therefore, the noting of the temperature is not important and may even be most confusing in early diagnosis (this excepts the subnormal temperature from collapse). The face is usually drawn and pale, the angles of the mouth depressed and the expression anxious. At the close of the case the examination

usually displays marked general distention of the abdomen, obliteration of liver dullness, vomiting, singultus, cold skin, facies Hippocratica, small running pulse, unconsciousness and Cheyne-Stokes respiration, after which the patient succumbs. Such is the observation of most of the neglected acute perforation cases.

There are others, however, in which the onset of severe symptoms is less distinctive. Quite naturally, when one has an ulcer case under charge (before perforation), the routine medical observances in the way of changes in the character of the pulse, intensification of the pains, the onset of abdominal muscle rigidity, rise in temperature and a leucocytosis, etc., should make one suspicious of this complication, and when these symptoms develop in sequence the transferring of the case to a surgeon is justified. It is in the subacute cases that the internist is very liable to delay until too late, and the cause of this in my experience is due to the belief that the early symptoms observed are those caused by perigastritis or lymphangitis from the ulcer and not primarily to perforation, or that the symptoms of perforation are not distinct enough for diagnosis or perhaps not present at all until a local or a generalized peritonitis has ensued. It is here that the internist shoulders a great responsibility, and one which requires his closest attention and analysis. At the least suspicion, a blood-count should immediately be made, followed by successive counts every few hours, depending upon the character of the case. If the leucocytes keep steadily rising in numbers (whatever figure they begin with), and the neutrophiles relatively increase and perhaps the eosinophiles coincidentally diminish or become absent, our duty to the patient is to insist upon immediate surgical intervention. We may be mistaken in the advice, but this is a matter in which a dozen mistakes are no arguments against the one that is correct. We can hesitate in the matter of surgical intervention for hemorrhage (even copious), but not in the presence of only a good suspicion of perforation.

Other cases again develop the symptoms of perforation as the first symptom of ulcer. These may be in individuals who have had more or less prior gastric disturbance, and they may be in those who had not. In these, a sudden pain in the abdomen, usually after a strain such as in vomiting, defecation, bodily exercise, a heavy meal, trauma, etc., and which pain is followed by the above enumerated symptoms, should put one on guard of the possibility of perforation.

Cases of pseudoperforation have been reported, but they have been very few, and do not justify a hesitancy of surgery in the light of the great advances that upper abdominal surgery has made in recent years and the doubts that surround many of these cases from the internist.

standpoint. When the patient is young and the surgeon experienced, the element of danger is small. It was no discredit to Manges to have had a young woman operated upon who had previous signs of ulcer and suddenly developed pain and tenderness in the epigastrium with rigidity and a temperature of 102° and a pulse rate between 120 to 140, even if no perforation or peritonitis was found at operation. That was one case; the next hundred might be cases of perforation in which the course and results would be justified.

In cases in which the perforation leads into the lesser peritoneal cavity, or through the diaphragm and into the cavity of the chest or heart, the symptoms may be modified thereby. In gastric ulcer the respiration must be recorded regularly, and whenever these rise perceptibly the chest should be examined for fluid or gas in the pleura. The onset of chills and a septic temperature should draw attention to such conditions as hepatic, subphrenic or mediastinal abscess, or septic conditions in the lung, pleura, or general body.

#### EXULCERATIO SIMPLEX.

This condition was originally described by Dieulafoy in 1898 and I have met with several cases in my practice. It is probable that the lesion is no where near as rare as is supposed.

The ulceration is generally circular. It may be elliptical or stellate. As a rule it is a small punctiform hemorrhagic lesion and while it may be met with in alcoholic, cardiac or cirrhotic patients, it often occurs in the absence of these conditions. It may occur in any region of the gastric mucosa, and is a soft lesion without edges. Its depth is usually that of the mucous membrane and oftentimes the lesion is missed unless carefully searched for. On microscopic examination the lesion usually proves to be an ulceration due to the disappearance of the mucous coat with its muscularis mucosæ. The arterioles of the stomach show often an arteritis. The condition is probably caused by an acute toxic-infectious process and it is possible that it is ulcerative process which takes place in the follicular gland of the lower section directly above the muscularis mucosæ.

It usually occurs in a young subject most often in the male, in an individual who has never had any gastric pain or dyspeptic troubles and apparently free from any gastric lesion. The onset is that of a sudden malaise with vertigo, nausea and weight in the stomach due to the accumulation of blood and then the vomiting of considerable quantities. It may be said that its clinical history commences with hemorrhage, which occurring in an individual in whom no other cause for hemorrhage could be ascribed, suggests the condition especially if alarming

amounts of blood have been vomited. While fatal gastrorrhagia is relatively rare in simple ulcer, lightning-like hematemesis is much more frequent in exulceratio simplex, in which it constitutes the most important sign and sole danger. Usually the ulceration is down into one of the arterioles which vessel it destroys laterally.

The test-meal findings are negative. In some instances there is a hyperacidity, in others there is an achylia. Only the presence of large amounts of blood would make one suspect the condition while hemorrhage usually takes place abruptly and terminates the same way; thus it is that test-meal findings are negative. The lesion is so small that it cannot be designated by X-ray examination.

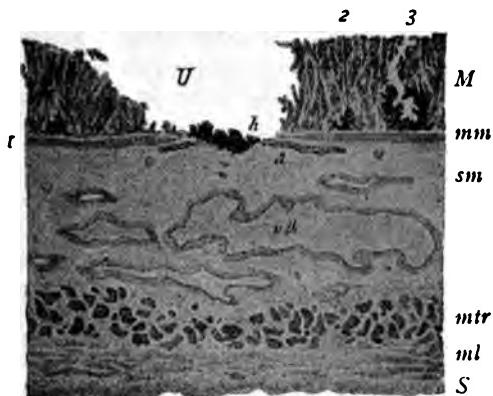


Fig. 114.—Section through the wall of the stomach. *U*, ulceration formed at the expense of the tunica mucosa *M*, and of the muscularis mucosæ *mm*. *a*, Small submucous artery destroyed at the point *h*, where a quantity of red blood-corpuscles are found *en masse* (it was from this spot that the fatal hemorrhages proceeded) *v*, *th*, Thrombosed vein. *sm*, Tunica submucosa, *mtr*, and *ml*, Tunica muscularis. *S*, Tunica serosa. 1, 2, 3, Miliary abscesses, situated in the depth of the mucosa. (*Dieulafoy*.)

The diagnosis of the condition generally resolves itself into two factors, first that of frank hemorrhage coming on abruptly, and secondly, this in an individual who has no ascribable cause for the hemorrhage. Blood from the lungs being excluded, one must think of an aortic aneurysm, cardiac disease, cirrhosis of the liver, chronic malarial conditions with enlarged spleen, esophageal varices, gall-stones which may cause frank hematemesis, and angiocholitis.

The prognosis resolves itself into the resulting balance in the patient's favor from the hemorrhage. If the hemorrhage is overwhelming death may ensue in a short time. If it is not and the bleeding does not recur, recovery is usually obtained.

The beginning of treatment is usually that necessary for a large internal hemorrhage, detail of which need not be gone into here. No foods should be allowed by mouth for hours and even days. The medication should be carried on hypodermically or by rectum.

There being no second hemorrhage, the treatment is that given for ulcer in general. If there is a second hemorrhage, however, the operation of incision through the anterior walls of the stomach and careful search for the bleeding vessel and excision of that area may be required to save life.

Every case of simple ulceration that I have seen has had positive Wassermann reactions. The condition is undoubtedly due to syphilis.

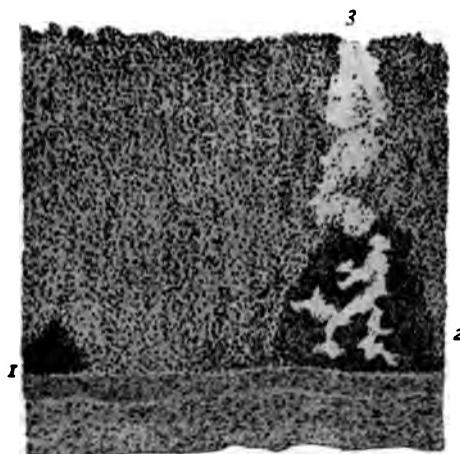


Fig. 115.—Tunica mucosa, with its muscularis mucosæ, 1, Miliary abscess in formation in the depths of the mucosa above the muscularis mucosæ. 2, Miliary abscess, opening through the tunica mucosa, and communicating with the cavity of the stomach at the point 3. (*Dieulafoy*.)

This also pertains to fissures that may occur in the gastric mucosa. The latter are more liable to give histories of vomiting of blood than the cases of simple ulceration. In these instances, together with the usual dietetic and medicinal treatment for ulcer, salvarsan, mercury and iodide are called for.

Gastric perforations carry a distinctly higher mortality than duodenal. The mortality of both gastric and duodenal perforations is high after middle life. One-half the cases of perforation, treated by suture alone, were apparently cured following operation. Therefore, an additional gastroenterostomy may well be avoided in cases of gastric perforation, in patients beyond middle life, and in any case where the general condition or lapse of time since perforation suggests possible death from peritonitis.

**SPECIAL CONSIDERATION OF DUODENAL ULCER.**

As is noted in autopsies, simple ulcers of the duodenum are about as frequent as those of the stomach (in about the proportion of 2 to 1.6); although from a surgical standpoint they may be encountered in higher proportions, Mayo recently reporting, in 621 authentic cases operated upon, 401 duodenal to 201 gastric ulcers, and 19 in which both gastric and duodenal ulcers were met with. Like gastric ulcers, most of the cases are met with in those in the second and third decades of life, although no age is exempt. According to the sex statistics from the best sources, there is a reversal in duodenal ulcers as compared to the gastric, duodenal ulcers occurring more frequently in men than in women in about the proportion of 4 to 1. Considering the number of cases in the four portions of the duodenum, it can definitely be stated that the nearer to the pylorus the greater is the percentage. Practically all of those in the first portion extend to within three-fourths of an inch of the pyloric sphincter, and the deepest portion of the ulcer is just outside of the pylorus, where the acid chyme readily affects the intestinal mucosa. As regards site, of 454 cases Martin<sup>3</sup> gives this as 91 per cent. in the first portion, 7 per cent. in the second portion, and only 2 per cent. in the third and fourth portions. They may occur single (50 per cent.), double (20 per cent.), or number more than two, and may occur in the duodenum alone or may be present here and in the stomach at the same time. The great majority of duodenal ulcers, as they are clinically met with, are chronic in type.

From a clinical standpoint what has been stated regarding gastric ulcer is also true of the duodenal. The clinical and surgical features of gastric and duodenal ulcers are so closely allied that a consideration of gastric ulcers cannot be separated from the duodenal. This is made still more forceful by the fact that at the time of perforation this is often so close to the junction of these two organs that the perforation could be referred with equal frequency to either one or the other viscus according to the judgment of each operator. Regarding the special clinical features of duodenal ulcers as compared to those of the gastric, there are a few things more to be said than were included in the symptomatology of the latter.

Among the special clinical points in differentiating ulcers of the two sites first may be mentioned the pain. In my experience, this is apt to be not so acute as in gastric ulcer and more burning and boring in character. It is present in a regular way (syndrome) in about 80 per cent. of all cases, and it is commonly located in the midline or slightly to the right. In other cases, however, it is most acute and excruciating, and

may even be complained of close to the right costal margin, but rarely out or down as far as the location of the gall-bladder (under the tip of the ninth right costal cartilage). Remissions of pain are often a distinctive feature, and when present the paroxysms are usually observed from one to three hours after ingestion, when the ulcer site has been mechanically and chemically irritated by the acidulous food. Pain that is instantly relieved by the alkalies suggests gastric origin, and when not relieved until later (three hours) suggests, when other symptoms are present, that the ulcer is in the duodenum. A characteristic pain I have observed on several occasions is one that comes on about 2 o'clock in the afternoon, intensifying until almost midnight, after which it disappears, not returning until the next afternoon. This is probably because at midnight the irritation from foods passing over the ulcer in the duodenum has ceased and does not return until that of a luncheon has been added to that of a breakfast taken a few hours before. Pressure upon the duodenum over its horseshoe course around the umbilicus usually elicits tenderness, this being between the stomach and the biliary triangle. Characteristic of duodenal ulcers is the relief of pain on taking foods. Many theories have been advanced for the production of this so-called "hunger pain," but, in my belief, it is due to the new foods causing a closing of the pylorus for the time being more than to the binding of the stomach acidity. This "hunger pain" is commonly present at night, requiring foods to relieve it and permit sleep. A special tenderness may be confined to the right side of the spine, although this is an uncommon symptom and not to be depended upon in diagnosis even when present.

Vomiting is not so common as in the gastric form, and may even be absent altogether. When it occurs admixture with blood is rarely seen, or the blood occurs only when vomiting has taken place late after ingestion and before all of the food has left the stomach. At these times it is usually due to regurgitation of blood through the pylorus, which can occur only when most of the food has left the stomach and the pyloric closure is constant; still, it must not be forgotten that even vomiting of blood late after meals is seen in gastric ulcer. Naturally, if bile is present with the blood one would be inclined to feel that regurgitation had taken place and that the site of the ulcer was beyond the pylorus. Altogether, vomiting is less common than pain. The return is more frequently acid and occurs usually when food is in the stomach.

**Hemorrhage.**—A copious hemorrhage into the stomach may occur with ejection, or the same may take place into the bowel with melena. A case which presents the clinical picture of ulcer in which the test-meal analysis does not display blood and the fecal examination does is very liable to be of the duodenal type. Incorporated blood in the

PLATE LXVI.



Duodenal ulcer in the posterior wall, and perforating. Site of ulcer just above orifice of bile and pancreatic duct, which is seen below the ulcer. Gall-bladder above and to the left, and which contained a single large, round stone weighing 6.8 grams.



stool is always suspicious of ulcer high in the intestine. Melena is at some time found in about one-half of the cases of duodenal ulcer and is a most important symptom of this affection. Blood may be present in the stools when the common clinical symptoms of ulcer are absent or too indefinite for diagnosis. When the bleeding is constant, the secondary symptoms of anemia (pallor, reactionary fever, weakness, loss of weight, etc.) are generally present. A case of mine that was operated upon presented a constant occurrence of large amounts of blood in the stools and no symptoms other than the anemia and loss of weight. This case was in an alcoholic, a history which in my experience is commonly obtained in ulcer of stomach or duodenum of the perforative type. As to hemorrhage and considering both gastric and duodenal ulcer together, about 30 per cent. of the cases give a clear history and about 70 per cent. a suggestive one of having had black stools. Altogether, however, about one-half of both kinds of cases will at some time show, macroscopically or chemically, the presence of blood in the feces.

Jaundice has frequently been observed from obstruction of the common bile-duct from catarrhal inflammation, or the coincident presence of ulcer with cholelithiasis—a not uncommon combination. Therefore, when the symptoms resemble biliary colic, especially the character and seat of pain and tenderness, and an intermittent jaundice is present, the differential diagnosis may be most difficult. The appetite is usually good in ulcer, but when pain exists there is fear of eating to satiety both in quantity and quality of foods; thus arise sub-nutrition and loss in weight. It has been a clinical observation of mine that in uncomplicated gall-stone cases the appetite is generally good and the patients eat well of all necessary foods and in quantities large enough to maintain good nutrition; this is a clinical distinction that has helped me in separating some of these two types of cases. Distinct gastralgia is not as common in duodenal ulcer as it is in the gastric variety.

Perforations with serious consequences are liable to occur. Most of these are found in the anterior or unprotected wall of the viscus and by far the largest proportion are near the pylorus. Exceptionally the posterior wall is involved. Those in the second part on the anterior surface lead directly into the general peritoneal cavity, while perforations on the posterior surface are, for obvious reasons, extraperitoneal. Perforations in the third and remaining portion of the duodenum are exceedingly rare.

The rapidity with which the resulting peritonitis develops varies according to the size of the perforation, the amount and condition of the escaped contents, and the ease with which this can pass to the

more remote parts of the abdomen. The more infectious and acid the material, the greater is the intensity of peritoneal infection. It is for these reasons, and because the duodenum is tightly attached to the spine and overlaid with motile viscera, that the perforations of duodenal ulcer are more infectious and dangerous, and the results from operation not as good as they are in those of gastric ulcer. Still, one is quite as fatal as the other, and life is rarely saved unless the patient is operated upon within the first twenty-four or thirty-six hours. For obvious anatomical reasons, perforations of the posterior wall are liable to have the infection localized for a time.

#### DIAGNOSIS OF GASTRIC AND DUODENAL ULCER.

When the classical symptoms are present (which occurs in about one in four cases) diagnosis is easy. In a rough way it may be said that by the closest attention and study in each instance, about two out of the remaining three cases can be diagnosed, and that in making these matters of X-ray examination, special technique and the laboratory offer most substantial aids (these include the cases of erosions and some hemorrhagic conditions of the stomach, which in practice must be included as ulcerated conditions and in which the diagnosis is rather accidentally stumbled upon or, on the other hand, made only after a length of careful observation). In the remaining cases diagnosis is impossible unless complications or sequels develop. As a rule, the diagnosis of the seat of the ulcer is impossible in definite ways, and it may be said is not important from either the medical or surgical standpoint. However, some of the recently advanced ways of arriving at this may be tried, and the most important of these are the following:—

Bönniger<sup>4</sup> has reported two methods of investigation that may be of service. The first is the increase in the pain of the ulcer by the introduction of acid into the stomach. The procedure he employs begins with the passage of the stomach-tube in the morning before food is taken. If no contents are obtained, 100 cubic centimeters of water are poured in, and after slight movements on the part of the patient this is allowed to flow out. Through this procedure the pain of ulcer should not be increased. After the removal of this water, 100 to 200 cubic centimeters of decinormal hydrochloric acid solution is poured into the stomach through the tube. If ulcer is present sharp pains immediately appear, which can be dispelled by the administration of milk. According to Bönniger, if after these procedures there are no manifestations of pain it is safe to say that no ulcer is present. It is logical that a necessary condition to the application of this test is

that the stomach be empty, and, as the object is to increase the characteristic pain, it must be present in the case in the first instance. I have tried the test as above described in seven cases of the clinical type of ulcer; in four of these the pain was claimed to have been increased, although in none of them was I able to observe by change in the patient's attitude, expression, etc., that this was so. It may be that these were not ideal cases for the test because in each instance there was a return of acid fluid from the morning stomach before the water instillation (which is usual in gastric and duodenal ulcer cases), and thus the slight difference in the acid content before and after the acid instillation was not enough to observe a difference in the pain. Then, again, as retching and straining usually intensify the pain in ulcer cases and as these are commonly brought on by the passage of the tube, it was difficult to say whether the increase or institution of pain was due to the decinormal hydrochloric acid solution or only to the straining from the tube or to both together. Of the remaining three cases one was a case of catarrhal erosions with hyperacidity in which no change was noted even when the hydrochloric acid solution was drunk some time after the stomach had been washed out. The other two were typical acute ulcer cases, one with a normal secretion and the other with a distinct and continuous subacidity. In the first of these no intensification of the pain was observed, and the second claimed to have less pain after the procedure than was present before. In the light of these sadly too few observations, and because of my hesitancy to use the tube when the presence of an ulcer is only suspected and unless there are definite indications for its use during the course of treatment, I have modified the use of this procedure (no tube being used) in the following way: In the morning after a dose of Carlsbad salts in tepid water and when the bowels have moved, I give an Ewald meal. If at the height of its gastric digestion (one hour) the pains are not intensified, I give about 2 cubic centimeters of dilute hydrochloric acid in half a glass of water. Should this markedly intensify or bring on a paroxysm of pain I feel that I have another suspicious symptom of ulcer (not a positive one), and if it does not, I still do not exclude the possibility of ulcer.

The second method of diagnosis that Bönniger has found is by means of the Roentgen rays in the way of noting how accurately a painful point corresponds with any particular area of the stomach. This method, which I confess I first looked upon as a diagnostic curiosity, has been the means of some surprisingly accurate diagnoses in my hands. Of course, the ulcer must be large and deep enough or have adhesions drawing upon it to receive sufficient bismuth to give

more remote parts of the abdomen material, the greater is the intensity of these reasons, and because the duodenum and overlaid with motile viscus, duodenal ulcer are more infectious and the operation not as good as they are it is quite as fatal as the other, and life is operated upon within the first two months. For obvious anatomical reasons, perforation is more likely to have the infection localized for a time.

#### DIAGNOSIS OF GASTRIC AND DUODENAL ULCER

When the classical symptoms are present (in four cases) diagnosis is easy. In a few cases, however, the closest attention and study in each of the remaining three cases can be diagnostic. In the matters of X-ray examination, special techniques are most substantial aids (these include the characteristic conditions of the stomach, which are ulcerated conditions and in which the disease has stumbled upon or, on the other hand, made observation). In the remaining cases diagnostic complications or sequels develop. As a rule, diagnosis of ulcer is impossible in definite ways, and it depends from either the medical or surgical standpoint. Recently advanced ways of arriving at this diagnosis are the following:—

Bönniger<sup>4</sup> has reported two methods of service. The first is the increase in the introduction of acid into the stomach. This begins with the passage of the stomach-tube after food is taken. If no contents are obtained, water is poured in, and after slight movements the patient this is allowed to flow out. Through the tube of ulcer should not be increased. After the tube is passed 200 cubic centimeters of decinormal hydrochloric acid are poured into the stomach through the tube. Pains immediately appear, which can be distinguished from the pain of milk. According to Bönniger, if after the injection of acid there are no manifestations of pain it is safe to say that the ulcer is healed. It is logical that a necessary condition to the

healing of the ulcer is the presence of an irregular line situated at or near the center of the ulcer. The size and shape of the ulcer, the nature of the procedure, the amount of acid injected, etc. are not important factors in the diagnosis of ulcer. The following diagram illustrates the method of diagnosis:

an irregular line to the contour of the stomach and the ulcer must be situated at or near one of the curvatures to observe this (ulcers of that size are usually diagnosed easily enough without resorting to the procedure). But when pain, vomiting, hematemesis, intolerant stomach, etc., are not distinctive enough in the case, and when the persistency of the gastric distress and the suggestions from gastric and fecal analysis are present, the method should be tried, because, even if an ulcer be present and it could not be observed, still much useful information as to the shape, size, and position of the organ is obtained and thus arise the possibilities of the diagnoses of perigastritis or perigastric adhesions. A most efficient X-ray apparatus is required and the exposure must be quick and made between respirations, because the detail for diagnosis covers only a small area on the plate and it must be definite for positive conclusions. The skiagraph is made as follows: The site of the tender area is accurately noted and this location is confirmed with the patient lying flat on the abdomen. This is then marked with a small lead cross or P to represent pain, and a coin is placed at the umbilicus and another at the ensiform. The bismuth mixture is then given in the sitting or standing position, immediately after which the exposure is made with the plate on the table and the patient lying with the abdomen upon it. The tube is at the rear and diaphragmed and the rays directly traverse the body from the back to the front so that the pyloric region is distinctly outlined. An irregularity of the stomach corresponding to the cross or P strongly suggests the presence of ulcer at that site. When the skiagraph has been properly taken, a negative result does not exclude ulcer, because such may be in the anterior or posterior wall of the stomach or duodenum and not be shown in the plate.

The eight roentgenoscopic characteristics of gastric and duodenal ulcer are as follows:—For gastric ulcer:

1. Diverticulum of perforating ulcer.
2. Visualization of bismuth-filled crater of a callous ulcer.
3. The incisura, or transverse contracture, indenting the greater curvature.
4. Localized pressure tender-point on lesser curvature.
5. Residue after six hours.
6. Acute fish-hook form of the stomach, with displacement to the left and down.
7. Delayed opening of the pylorus.
8. The settling of the bismuth to the lower pole of the stomach, such as is seen in hypertonicity or atony.

For duodenal ulcer:

1. Early, free opening of the pylorus, with early clearing of the stomach.
2. Lagging of bismuth in the duodenum.
3. Residue in the stomach after six hours.
4. Pressure tender-point over the duodenum.
5. Dilatation of the cap.
6. Irregular outline of the cap or duodenum.
7. Diverticulum of a perforating ulcer.
8. Vigorous peristalsis, especially if there is obstruction.

Einhorn<sup>5</sup> has advanced a method which consists in the swallowing of a "duodenal bucket" attached to a long silk thread. The bucket is swallowed in the evening and is removed in the morning before breakfast. According to this author, if an ulcer is present a brown or dirty black discoloration is found on the string, and by measuring the distance of the discoloration from the teeth the site of the ulcer can be approximately determined. Some years ago I employed, with satisfactory results in cases of esophageal disease in which there were suspicions of ulcer or cancer of the gullet, a length of No. 15 surgeon's braided silk with an ordinary, small-sized shoebutton tied to the end. The length of string was proportionate to the height of the individual and was measured by holding the button at the level of the spinous process of the tenth dorsal vertebra, from whence the string was passed up to the nape of the neck, and then loosely over the ear and forward to the lips. At a point about 10 centimeters beyond this a knot was tied in the string, and the shoe-button and all of the string to the knot was swallowed and retained overnight, the outer end being fastened with adhesive plaster to the cheek beyond the angle of the mouth. The string was slowly withdrawn in the morning and observed as in the Einhorn method. I see no special reason why a more expensive and less easily obtained apparatus need be employed for ulcers situated lower down. Of course, the string would have to be longer for pyloric or duodenal ulcers, and an additional length equal to between 25 to 38 centimeters (10 to 15 inches) would be sufficient; the extra length would depend upon the shape of the stomach, for in marked degrees of prolapse it would have to be still longer.

Instead of the use of the shoebutton, a BB split shot may be employed, fastened to the end of about 100 centimeters (38 inches) of No. 8 braided silk. The shot is inclosed in a 5-grain capsule, the cord passing through a small hole in one end, and a knot is tied on the string 75 centimeters (28 inches) from the capsule. I would advise that a number of these be made up and kept on hand, each one wound around a card, and placed in an envelope having the following instructions upon it:—

For several hours before beginning this test no medicine should be taken, and for supper no meat is allowed, the meal preferably consisting of milk, eggs, bread and butter. At bedtime you are to swallow the capsule and thread until the knot is at the teeth. The end of the string is then made into a loop and fastened to the nightgown with a safety pin or tied around one ear, so that the knot remains in place—the shot remaining in the stomach all night. On awakening, pull the string slowly and steadily and hang it up to dry, being careful not to allow anything to touch it while wet. When dry, place it in a clean envelope and mail it to or leave it at my office.

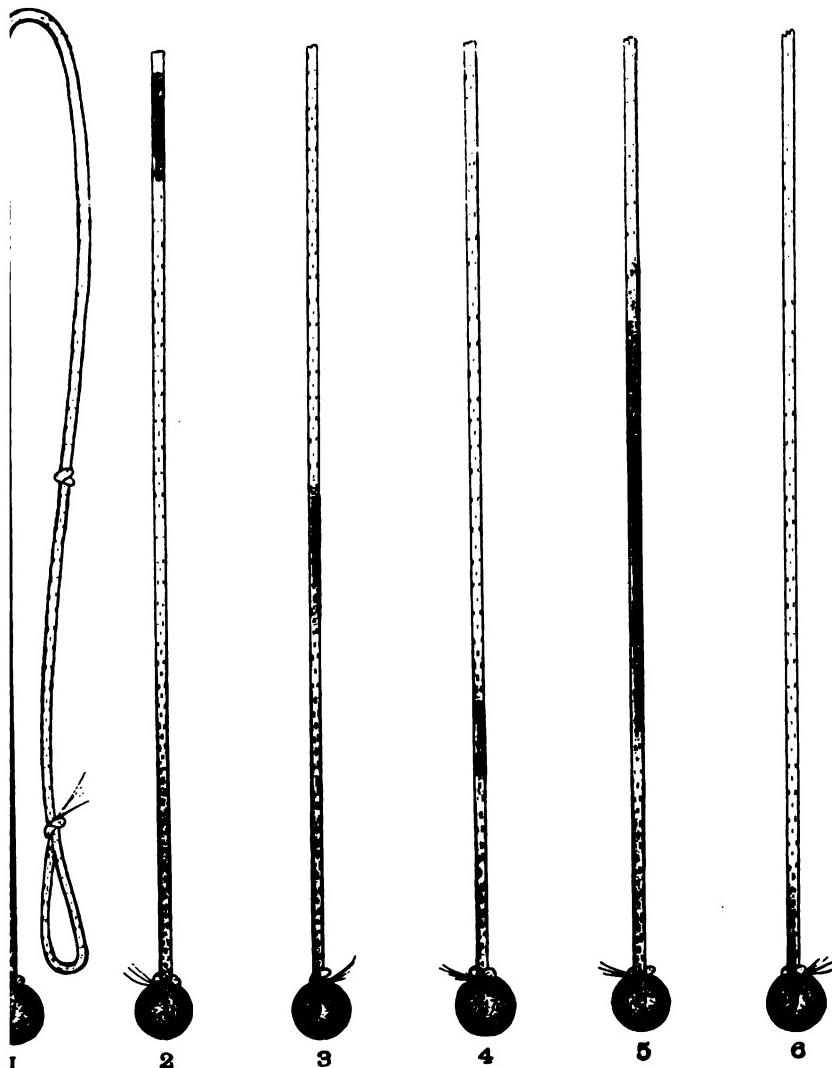
The string test is a valuable means of diagnosis in gastric and duodenal ulcer, as well as those of esophageal ulcer, and of cancer in these parts of the digestive canal. A number of my cases have been most easily diagnosed by it, and not a few of these had none of the cardinal symptoms of ulcer present. This is true particularly in the latent cases, and the test is not disagreeable nor objected to by patients. Finally, it may be used to note how an ulcer case is progressing under treatment. Occasionally one meets with a "positive string" and no ulcer present. These are instances of trauma due to tightness of the string in the lesser curvature with bleeding and congestive conditions of the pylorus. It is essential to try the string test several times and only when positive on all occasions to consider the finding worth the while.

This method is not of value in ulcers of the fundus and greater curvature of the stomach. For the localization of these, Einhorn has devised a bag covered with gauze, which is introduced into the stomach in the collapsed condition and is then inflated. At the end of half an hour the bag is allowed to collapse and is withdrawn. According to this author, if ulcers are present, brownish areas will be noted on the gauze corresponding to the site of ulcer. The latter method is only applicable to patients who are accustomed to the use of the stomach tube. Personally, I have had no experience with the latter method.

The X-rays may be helpful in diagnosis of gastric ulcer, particularly in those in the lesser curvature and in the anterior wall. For the duodenal ulcer they are of no value, excepting when adhesions or marked defects are present. Many pylorospasms are due to ulcer either in the stomach or duodenum.

In the differential diagnosis between ulcer conditions and others may be mentioned particularly gastralgia, hyperesthesia, cancer, hyperchlorhydria and gastrosuccorrhea; hemorrhagic and other forms of gastritis, particularly gastritis acida; pylorospasm, appendicitis, pregnancy with hyperemesis, the various conditions in which blood may be swallowed or gain entrance into the stomach, uremia, biliary conditions and kidney stones, arteriosclerosis, spinal disease and others. A dis-

PLATE LXVII.



Results of the string test in different conditions. No. 1, Normal; the bile-stained lower end usually stains the string for a distance of about 15 cm. (6 inches) from the shot, gradually fading out on the way upward. No. 2, oesophageal ulcer, the blood-stain corresponding to above the cardia. In oesophageal carcinoma, because of the stenosis, the shot and string may remain in the gullet and a considerable extent of the lower end of the string be blood-stained; in this instance the lower end of the string would not be bile-stained. No. 3, Gastric ulcer, the blood-stain corresponding to the lesser curvature of the stomach near the pylorus, but at the upper end of the bile-stain. No. 4, duodenal ulcer; the blood-stain is small in area, and the bile-stain extends beyond it, showing that the bleeding is beyond the pylorus in location. No. 5, astreic carcinoma, showing that considerable hemorrhage was taking place, staining the string throughout the stomach. Some of the cases show a blood-stain small in extent, and, if the pylorus permits the passing of the shot, a bile-stained end; the string then would resemble that of gastric ulcer. Other cases show a general blackish-green staining of the string, which displays the presence of blood by the chemical tests. No. 6, Gastrophtosis, showing that a long, attenuated stomach took up the distance of string, permitting but a small extent of it to get into the duodenum.



tinction must be made between various types of post-ulcer conditions, and these will be offered under the separate heading which follows.

**Gastralgia.**—In gastralgia the pain is dependent on the ingestion of foods, and independent of their amounts and character and may even be stopped by the taking of them. The pain is usually burning and relieved by pressure or the application of heat. A cold sensation in the stomach may exist. There may be pressure points over the intestinal plexuses. If there be vomiting this is not liable to be much of a feature, stops in a few days, and the vomiting does not relieve the pain. The appetite is irregular and capricious, there is much eructation of odorless and tasteless gas, and salivation may exist with a constant necessity of swallowing. The chemism of the stomach is not especially altered, and the return does not contain blood, bile or lactic acid. Bacteriological examinations are indifferent. No fever is present, and the skin may be of normal turgescence but perhaps pale when the distress is acute. Hysterical and neurasthenic symptoms are common, and the symptoms of general distress may be out of all proportion to the degree of pain. The physical examination does not reveal a definite area of sharp pain, but rather a diffuse tenderness on pressure in the epigastrium. No symptoms of perforation are present, and epigastric pulsation may be observed when prolapse or atony is present. During the attack constipation is the rule, and afterward the passages may be fluid containing mucus, but no blood. The condition subsides in a short time, possibly without much if any treatment, and the distress soon abates entirely. A mild degree of hyperesthesia may persist for some time which generally subsides with the administration of the bromides. In simple hyperesthesia none of the acute symptoms exist, the symptoms practically are altogether subjective, and the patients are about and quickly respond to proper medical treatment.

**Cancer.**—In this affection debility and emaciation often precede the other signs. The pain is more constant, less severe, more independent of the ingestion of food, and often nocturnal in its appearance. Anorexia is frequent, the taste pappy or insipid, and aversion to meats commonly exists. The appetite may improve with lavage. Fetid eructations are frequent. Digestion is insufficient, stagnation of foods common, and the chemism in late cases shows the absence of hydrochloric acid and the presence of blood, Boas-Oppler bacilli, lactic acid and pieces of cancer tissue. The feces generally contain blood. Vomiting is common and gives less relief than in ulcer. Collective vomiting may be present. The hematemesis is often of the "coffee grounds" character; in ulcer, the blood is usually of a bright color. Epigastric pulsation occurs only with marked emaciation. A low degree of fever is common at the termina-

tion of life. Cachexia is marked, the skin being sallow, yellowish, brown, dry, or flaccid. Melancholia and indifference to things in life are common. The patients are usually aged between 40 and 60 years. Tumors of varying size and shape are distinctly palpable in the epigastrium. Involvement of the left lobe of the liver is common, and other metastases occur. Perforation is found only after long illness, and, when occurring into the colon, lientery may be present. The X-rays are strong factors in differentiation.

**Hyperchlorhydria and Gastrosuccorrhea.**—Distinct pain and tenderness are not present. Vomiting is rare and usually occurs after some indiscretion in diet. Epigastric distress is most marked from one to three hours after meals (hyperchlorhydria), or in the early morning when the stomach is empty of food and there is gastric juice in the organ (gastrosuccorrhea), although actual pain is rare. The laboratory findings are usually suggestive, a high hydrochloric acid content and a low conversion of the starches and an abundant return being the main points for diagnosis. In a case in which from continued dietetic and neurotic causes such test-meals are obtained, and in which the symptom of belching of acid gas or regurgitation of acid fluid exists, and postprandial distress (pyrosis) coming on when such foods as are in the stomach are supersaturated with gastric juice, the correct diagnosis is most often that of excess of HCl secretion. These conditions usually respond to proper treatment. When they do not, be suspicious of latent ulcer, an underlying gastritis, cholelithiasis, chronic appendicitis, or disorders of the nervous system.

**Hemorrhagic Gastritis and Other Forms of Gastritis.**—The diagnosis between ulcer and the rare instances of hemorrhagic gastritis is exceedingly difficult and usually impossible. The cases of the latter are liable to be in persons in middle life; the onset is acute, and the hematemesis may be excessive and repeated in ulcer cases. The history of pain, hyperchlorhydria and vomiting may be most suggestive of ulcer and still none be present. Even an exquisitely tender localized point of pain and an area of tenderness may be found. Blood is continuously present in the stools. There is always a chance, however, that the diagnosis may subsequently be made in the clinical exclusion of ulcer by the recovery of the patient (without complications or sequels). In this connection it is important to remember that surgery is especially prone to failure in dealing with excessive hemorrhage from the stomach, and thus it is generally advisable to hold to the medical measures of treatment as long as possible. Naturally, then, if the case entirely recovers and subsequent examinations are negative, one should consider the possibility of hemorrhagic gastritis as having been the past condition.

In ruptured varix of the stomach, in which much bleeding may be present and difficult to control, the classical symptoms of acute ulcer are usually lacking; thus the distinction of the latter disorder between the two above mentioned. In the ordinary forms of acute gastritis and sometimes in the hemorrhagic form, there is the history of cause followed by acute onset of the symptoms of vomiting of the food and possibly later on by mucus and bile. The pain is not so acute and is more diffuse. In the ordinary forms of chronic gastritis the history of cause and the characteristic findings in the various types of gastric analyses are important. When blood or eroded pieces of the glandularis are found the diagnosis of secondary ulcer should be made and the case treated accordingly. The differential diagnosis between ulcer and acute and chronic forms of gastritis as a rule is not difficult. With the hemorrhagic form it is quite difficult, and the diagnoses of ulcer erosions or "catarrhal ulcers" accompanying chronic gastritis are usually made by accident.

**Pylorospasm** not accompanying gastric or duodenal ulcer—which constitutes a most common combination—is a very misleading symptom. It may be present in the neurotic affections of both the stomach and the corporal types, in cholecystitis and gall-stones, appendicitis, and tuberculosis of the abdominal viscera, particularly the cecum and the colon as well as ulcer on either side of the pyloric muscle. The diagnosis of uncomplicated pylorospasm is usually made by the exclusion of all organic disease and the appearance of spasmodic attacks of pain in the region of the pylorus, with the coincident appearance of intermittent stagnation. The attack usually occurs at the height of digestion, at first rather indefinitely and only periodically, but later on more distinct and more frequent. After a time evidences of gastric dilatation ensue, and vomiting of food late after its ingestion is observed. Following the vomiting, relief for several days may be afforded, during which all of the symptoms disappear. During the attack a small, round mass (the contracted pylorus) may be felt which is tender on pressure and disappears in the interval of the seizures. Chronic gastrosuccorrhea may exist, and instances of tetany have been reported. The gastric and fecal analyses do not display the presence of blood and may be distinctive from ulcer in other ways. If the case has run a chronic course lactic acid may be present, but Boas-Oppler bacilli are rare.

**Appendicitis.**—The danger of mistaking cases of perforating acute gastric or duodenal ulcer for appendicitis, and *vice versa*, is great. In fifty-one cases Moynihan reports that the diagnosis of appendicitis was made nineteen times. According to my observation and experience, the latter figure is much too high when care has been taken in the

clinical analysis of the cases. It is probable that, taking into account only the severe instances of the perforative, gangrenous, and the rapidly fulminating types of appendicitis, these figures may not be too high. The difficulty is explained by the mentioned types of appendicitis causing rapid production of the alarming symptoms of peritonitis (identical with those of perforating ulcers), which, in a few words, may be expressed as a septic peritonitis of sudden onset, and the fact, as Payr has shown, that there is frequently an association between either acute or chronic appendicitis and erosions and ulcers of the stomach. This author expresses himself as follows: "In a certain number of cases of appendicitis, usually of moderate severity, there appear, shortly after the first attack, various gastric symptoms closely resembling those of gastric ulcer. There is pain, occurring shortly after the taking of food; hyperacidity; vomiting, frequently bloody in character, and, usually later, phenomena suggestive of pyloric stenosis. These symptoms generally abate after a short time, but frequently repeat themselves after each new attack of appendicitis. In other cases it appears more as though the ulcer extended deeply into the muscular layer of the stomach and caused chronic inflammatory changes in the serosa. In a large number of cases I have found band-like or scar-like adhesions in the neighborhood of the gastrocolic omentum or the anterior pyloric wall. In all of these cases perforation of the appendix could be absolutely excluded." These stomach lesions he attributes to the result of emboli derived from the thrombosed veins of the omentum and the appendix. According to Mahnert,<sup>8</sup> who undertook a clinical confirmation of the frequency and significance of this relationship claimed by Payr, and who studied 36 cases of undoubted gastric ulcer, it was found that chronic appendicitis was present in 23, or 64 per cent. of the instances. While there is no doubt that digestive distress commonly ensues after an attack of appendicitis and is present in the cases of chronic appendicitis, I believe these figures to be high in so far as the cases of true appendicitis are concerned. In the argument against the greatness of the figures it must not be forgotten that instances of appendicular disease—even unknown during life—are very common, and the same may be said concerning ulcered conditions of the stomach. In my experience, nowhere near the proportion of cases in which this association between the two might be present was apparent either after an appendectomy for appendicular disease, or the late clinical observation of ulcer cases that had been treated and which most probably did not then have or subsequently developed appendicular disease. So long as persons persist in eating, drinking, and living improperly, so that causes for gastric disorders are at work, that long must we consider this association to be present in only

the small minority of cases, the neurological gastric conditions secondary to chronic appendicular disease to be the combination in somewhat more of the instances, but that there is no association of the two conditions at all in by far the largest number. Judging from the large number of cases of gastric disease that come back for treatment for digestive disorder after an appendectomy has been performed, I believe that the average surgeon should be more guarded in promising cure of digestive disorders when an inflamed appendix has been removed. The majority of them are not so cured, and I may incidentally remark that this belief pertains also to the ophthalmologist, gynecologist, and others. Viewing patients as we see them, and not from the dead-house side, the sequence of appendicular disease (possibly only the suggestive history of attack), then the onset of gastric disturbance (which on analysis proves to be a *bona fide* condition), and then some strong evidences of chronic appendicular disease present are necessary for the logical sequence of cause and effect, and before a promise of cure can be substantiated in the majority of cases of appendicular disease treated from the surgical standpoint.

In separating severe cases of acute appendicitis from perforating ulcers of the stomach area the situation of the onset of pain is most important. Muscular rigidity, local pain on pressure, and tumor, whether below the transverse line of the umbilicus or above it, are guiding points. When, because of abdominal septicemia or peritonitis, or both together, the abdomen becomes distended, the differential diagnosis is not possible or important, and thus no delay should be permitted. The abdominal cavity should immediately be explored by an incision in the most favorable site and manner for examination of both of the lower and upper abdominal zones. What we are dealing with then are serious consequences, not primary conditions, and these require surgery; the differential diagnosis between the two causative conditions can in every instance be made surer and safer by the surgeon.

**Pregnancy with Hyperemesis.**—Here the history and the local examination of the case are the best means of making a diagnosis. No pain is present, and the characteristic symptoms of ulcer are absent. The same may be said of the instances of vicarious menstruation, and the various conditions in which blood may be swallowed and vomited or gain entrance into the stomach directly from the gullet or by way of it.

**Uremia.**—The absence of excretion of urine, or the examination of that obtained will be characteristic. These, with the symptoms of headache, sleeplessness, paralysis, amaurosis, convulsions, mania,

delirium, coma; increased arterial tension, and dyspnea are important. General muscular spasm and fever may be present. When consciousness exists the examination of the abdomen is negative, but late in the case distention without rigidity may be observed. The vomiting may be incessant, and if a uremic ulcer exists in the stomach blood may be found in the vomitus or feces. In my experience, the vomitus is usually gastric juice, particularly when fever is present. This brings me to record the fact that, when for any reason a moderate or high fever has been present for some time (including the infectious diseases), the vomitus and stomach findings are commonly anachlorhydric and even achylic during its course.

**Biliary Conditions and Kidney-stones.**—In gall-stones when the tenderness is confined to deep pressure in the biliary triangle and jaundice with bile in the urine and the characteristic pains exist, the diagnosis is easy. But when the pains are constant, as in ulcer, especially after the taking of foods, and with it there is vomiting which affords relief, and the symptoms of gall-stone disease mentioned are lacking, time and careful observation are usually required in separating the cases. Cholelithiasis cases are liable to be ruddy in complexion and well nourished, while those of ulcer often display anemia and subnutrition. There is usually a history of long intervals between the paroxysms of pain, with a much better digestion than is seen in ulcer cases. In my experience, the gastric analyses rarely show the presence of blood, although after the paroxysm a positive test may be obtained from the feces—not in the interval. The gas results from test-meals are generally negative, and hyperacidity is common. It must not be forgotten that duodenal or gastric ulcer may exist with gall-stones. In most of these cases the diagnosis of gall-stones is easier to make than that of ulcer, unless the latter perforates or copious hemorrhage ensues. If a chill with fever, enlargement of the liver, and a swollen, tender and palpable gall-bladder exist, the diagnosis is suggested, and this is confirmed should stones be found in the feces in the first few days following the attack. Attacks of hepatic colic may cause difficulty, although there are certain characteristics about the history and examination that make differentiation a possibility in most cases. The attacks of pain may occur in the epigastrium, but they quickly radiate to the right costal margin, around to the back and underneath the right shoulder blade. The pain is more colicky in character, with remissions and exacerbations, coming on more suddenly and ceasing more abruptly than the pain of either gastric or duodenal ulcer. The pain and the suffering are more acute, and are regardless (usually) of whether food has been taken or not. While the attack lasts, the patient often feels chilly, sweats profusely, is nauseated, and vomits, and usually

there is a slight rise in temperature, with jaundice following in about 50 per cent. of the cases. The right side of the abdomen is rigid and painful to pressure in the attack, especially during inspiration, and these may persist more or less in the interval. The history of attacks of hepatic colic, the absence of the findings leading to the diagnosis of ulcer, and this limitation of pain and tenderness on pressure in the biliary triangle, particularly when the front of the abdomen is palpated from behind, the patient sitting before you so that you can get your hand well under the right lobe of the liver for deep pressure on the gall-bladder, are the main points to separate the chronic gall-bladder conditions from gastric and duodenal ulcer. In renal calculus the urine is strongly acid and contains blood, usually enough to give it a smoky tint. Small concretions may be passed per urethram, or shadowed in the pelvis or ureter by X-ray. The intensity of the back pain radiating downward (usually only one side), and the absence of pains and a point of tenderness in the upper and anterior abdominal regions are important. The examination of the abdomen is negative, or the entire abdomen may be board-like during the paroxysm of pain caused by the passing of a calculus through the ureter.

**Arteriosclerosis.**—This occurs in old people, and when sclerosis exists in the vessels of the upper splanchnic area abdominal pains may exist. The characteristic symptoms of ulcer are absent, and the gastric contents commonly achylic. The condition is essentially chronic, and attacks of angina are frequently present. The palpable vessels are firm and arterial tension persistently high until cardiac compensation fails. A large amount of urine may be voided, and this often shows a low specific gravity, a small amount of albumin, and casts of the granular variety. Aneurism of the large internal arteries may exist. Putrefactive conditions in the intestines are common.

**Spinal Diseases and Others.**—Among the conditions that have been mistaken for gastric ulcer are: tabes with gastric crises, myelitis in which pains are a prominent feature, movable kidney, the colic of lead poisoning, enteralgia, herpes zoster involving the lower dorsal nerves and before the eruption has developed, intercostal neuralgia of the lower chest nerves, and diaphragmatic and lung base pleurisies. The individual features noted by the routine examination will in each of these conditions generally clear up the doubts in differential diagnosis.

#### DIAGNOSIS OF THE POST-ULCER CONDITIONS.

The subject-matter pertaining to late perforation has already been given. It suffices here to repeat that perforation may be met with in the

sequent conditions as well as during the course of an acute ulcer, and, in fact, it is more common by far in the more chronic conditions.

**Perigastritis.**—When the ulcer has extended to the serosa and inflammation takes place, a plastic exudation is deposited which usually results in the formation of adhesions. There is no doubt that certain conditions other than ulcer can cause a localized perigastritis and adhesion formation. Notable among these are the forms of gastritis that are due to recurring attacks of acute gastritis (chronic pyloritis), which, whether from simple catarrhal extension to the outer surface or direct infection from within, subsequently causes the development of the condition. Also, no doubt, infections carried from the gall-bladder, pancreas, liver, appendix, or intestinal canal cause the condition in as many if not more of the cases than ulcer, although here the omentum and portions of the peritoneum other than that covering the stomach are more liable to involvement than that of the pyloric region; tubercular peritonitis must also be mentioned in this connection. Such adhesions, however, are not at all uncommon in cases of ulcers in which cicatrization has taken place, in which instances they are usually perigastric and most often affecting the pyloric region and lesser curvature. Of these Fenwick's statistics show:—

Organ.	No. of Cases.	Per Cent.
Pancreas alone .....	49	40.
Liver alone .....	33	26.8
Both pancreas and liver .....	10	8.1
Colon .....	7	5.7
Liver and colon .....	4	3.7
Mesentery .....	3	2.4
Spleen .....	2	1.6
Three or more organs .....	15	12.2

The adhesions occur to neighboring organs and the parietal peritoneum and may be suppurative in nature. At least 7 per cent. of all true ulcer cases show evidences of perigastric adhesions. They are usually observed as well-organized, firm, thick bands, and may extend far beyond the limits of the stomach, even to the pelvis. In ulcers of the posterior wall the pancreas is involved, while those of the anterior or lesser curvature are attached to the left lobe of the liver, the omentum, and parietal peritoneum. A triology of organs—the stomach, liver, and gall-bladder—may be found bound together in adhesions from the large simple and chronic ulcers of the pylorus.

The symptoms vary according to the extent, degree and location of the perigastritis, to the neighboring viscera affected, and the character of the inflammation—whether plastic, fibrous, or suppurative. In the early stage of ulcer, the onset of the local irritative phenomena (retching,

distress, dull pain, and possibly fever) should bring one's attention to the serosa involvement. In the average acute case the symptoms of ulcer predominate, and under treatment gradually fade away, and, even when a plastic exudate had taken place which results in adhesions, the latter complication or sequel is not recognized for the time being. Later on certain symptoms develop which are characterized by chronicity and resistance to all internal treatments and often are a source of great perplexity, particularly when no history of early ulcer or of gastric disturbance can be obtained. There are certain other features to these conditions that are often helpfully suggestive. Among these must be mentioned mild exacerbations of gastralgic pains, especially of the radiating character, which may be referred to the back or down the abdomen and which are brought on or intensified by certain movements of the body or occur only when the stomach is distended with food. Continued observance of the cases will often display a slight rise in temperature ( $37.1^{\circ}$  to  $38.4^{\circ}$  C.,  $99^{\circ}$  to  $101^{\circ}$  F.), coming and going at intervals and not possible of being accounted for in any of the ordinary medical ways, but which are due to congestion of the adhesions or the mild secondary disturbances that their presence sets up. Some loss of flesh and a persistent degree of subnutrition occur, but there is no cachexia. On examination more or less indistinct tumor formation may be felt, accompanied with tenderness and resistance on pressure. These are usually subcostal, and, unless superficial, may be most confusing. Special examinations of the stomach by inflation render no aid, for the reason that the pylorus is deeply set under the liver and its position is not changed to a degree appreciable from the outside. A gastrectasis which follows an ulcer is due either to adhesions that are binding down the pylorus, gall-bladder, or liver; to contraction of an ulcer cicatrix bridging the interior of the organ, or to the onset of malignant disease. Helpful in separating the primary atonies and primary malignant disease from these are the gastric analyses, for in the three above mentioned the gastric findings are usually negative or not sufficiently pronounced for the differentiation of chronic gastritis and distinct malignant disease. With precardiac perigastritis the signs also vary. Among the symptoms that may be noted here are persistent and nondescript attacks of gastric distress, anorexia, local tenderness, recurring attacks of pain, vomiting without gastrectasis, a palpable plaque-like mass, interference with or distress on deep breathing, or possibly the onset of pains when the stomach is empty so that tension of the parietal adhesions of the stomach takes place.

When the adhesions involve the gall-bladder, jaundice may occur, which is liable to be chronic and suggestive of malignant disease of

the biliary region. The differentiation of these cases from malignant disease or uncomplicated cholelithiasis is usually possible after observance of the case. Adhesions affecting the pancreas often lead one to consider the diagnosis of the chronic forms of pancreatic disease (parenchymatous and interstitial). Fatty stools, large albumin loss, many undigested muscle fibers in the feces, the Cammidge test, and glucose urine are never observed in adhesions (excepting in the rare instances when the common duct had been occluded). Peritoneal adhesions binding down the intestines usually give rise to the symptom of constipation, or, in severe cases, obstipation and foregut dilatation. In diagnosing perigastric adhesions affecting the regular contour of the stomach or of the colon, radiography offers the best aid. By this means those obstructing the colon can only be diagnosed as "intestinal stricture," and it is usually necessary to depend upon operation to find out the true nature of the stenosis (whether adhesions or benign or malignant obstruction).

**Cicatrices Causing Pyloric Obstruction.**—Following the history of an ulcer which gave clinical symptoms, the onset and persistency of vomiting of the collective type, the evidence of stagnation accompanied with large amounts of hydrochloric acid in the stomach contents, and the objective manifestations of gastric dilatation always suggest pyloric stenoses. Among the conditions in the stomach that would then be present are notably four in number: (1) an unrelenting and contracting cicatrix diminishing the normal lumen of the organ; (2) perigastric adhesions which by traction or pressure cause obstruction; (3) pylorospasm due to the irritation of the pyloric sphincter from the ulcerated area, and (4) malignant disease accompanied with extensive connective-tissue deposit, enlarged lymph glands, and metastatic adhesions. The clinical differentiation of these cases, particularly when no prior history of ulcer can be obtained or is suggested, is usually quite difficult and often impossible. The case which Kussmaul describes (page 437), in which he first used the stomach-pump, answers for any of these (excepting possibly malignant degeneration), and thus will not be repeated. Because of the better state of diagnostics of the present day and the medical and surgical therapy in the care of these patients, such classical cases as Kussmaul described are few and far between, but occasionally one from some remote quarter will be heard of. Very much more often in practice are seen cases in which collective vomiting over such a long space of time is not present, and in these about all we can accomplish along medical lines is to make a diagnosis of pyloric obstruction, probably not due to primary malignant disease and continue observance over a length of time. Between cicatricial deposit in the pyloric region and duodenum and secondary pylorospasm the diagnosis is

especially difficult, because in the latter the classical symptoms of chronic benign obstruction may exist and at operation the pylorus so freely admits the passage of the finger that organic mechanical obstruction could not be the factor even should the pylorus be somewhat thickened. The diagnosis here is usually suggested in one of two ways: (1) the persistency or subsequent onset of gastric symptoms following an ulcer in a case which on analysis after seven, eight, or nine-hour intervals between ingestion and extraction of mixed meals displays a noticeable degree of stagnation with an excess of secretion; (2) when there is no prior history of ulcer, those that present a gastric atony with extraordinary secretion in the production of which no cause can be assigned, and which conditions do not improve under local and general treatments.

In thin subjects when the stomach is empty (preferably after lavage) it may be possible to detect a small-sized tumor at the pylorus. In my experience it is generally impossible to say whether the tumor that is palpable is due to a cicatrix or a thickening of the pyloric region secondary to pylorospasm or to a true muscular hypertrophy. Still, in a few instances of pyloric thickening the mass may be definitely made out as localized at the pylorus, and its small, hard state and mobility may help one. It must not be forgotten, however, that in late ulcer such thickenings of the pylorus are common, and may even be malignant in nature.

In the majority of these cases there is pain (often spasmic) in the region of the pylorus, which in each instance must be located by the X-ray plate. In slight degrees of stenosis this pain is infrequent, usually not severe, and is relieved or kept in abeyance by a fluid diet. In moderate degrees it is a very much more noticeable clinical feature, and in markedly stagnating stomachs it may be constant, intensifying at times into severe paroxysms. The X-ray plate may be very useful in diagnosing cicatrices, as well as perigastric adhesions, by the noting of changes in the contour of the stomach or its retraction under the liver or approximation to the gall-bladder.

Stenosis of the duodenum may result in any long-standing case, from fibrosis and cicatricial contraction of the ulcer base. Then the same train of symptoms and signs present themselves as in stenosis at the pylorus due to a gastric ulcer. The clinical picture is one of food stagnation, with regurgitation and vomiting, and of dilated stomach, easily discovered by succussion splash, by retained food in the fasting organ, and by the outline after inflation, and ultimately by definite and often vigorous peristaltic waves across the stomach wall. When such a complication arises, it is impossible to decide whether the stenosis exists at the pylorus or just

below it, and whether the case was primarily one of duodenal or of gastric ulcer. The only clue to aid in a decision will be the early history of the case, before stenosis developed.

**Hour-glass Contraction.**—This consists of a contraction of the stomach, anywhere between the cardia and pylorus, dividing the stomach into two or more portions. As a rule, but two sacs are present, but there may be three or four. The greatest thickening is generally at the cardiac side (which is usually globular), with a thinning out toward the pylorus in a sort of funnel-shaped canal.

The direct and most common cause for this condition is an old ulcer causing cicatricial contraction and diminishing the lumen of the organ. External adhesions are generally also present, and these alone may be the factor in binding down the stomach. Among forty-eight cases reported by Robson and Moynihan, forty-one were due to ulcer. Such conditions are also produced by carcinoma of the diffuse and connective-tissue type, and a few rare cases have been reported of this condition as a congenital deformity. It is possible also that certain forms of hyperplastic chronic gastritis may, without prior ulceration, cause the condition.

The subjective symptoms are usually variable and indefinite, there being no symptom or symptom-complex that suggests the condition in any instance. Among those that are apt to be present are pain after meals, vomiting of the stomach contents and perhaps also of blood, the necessity of eating only small amounts of food, and the onset of acute distress when the capacity limit of the cardiac sac has been reached. The history of stomach disorder generally spreads over a long space of time, may be suggestive of pyloric stenosis, and may or may not have been begun with a definite history of ulcer (in my experience the history of prior ulcer is uncommon). On examination of the patient a degree of anemia, subnutrition, or emaciation is commonly observed. Remembering that the narrowing is usually near the pylorus and that the capacity of the cardiac end is more or less sharply defined according to the degree of contracture, it is easy to understand that this end assumes a globular shape. The constant distentions with food and gas cause a bulging of this sac, which often results in rendering more prominent the left costal arch. In one of the cases under my observation this bulging was most prominent after the ingestion of foods, and a distinct peristaltic wave was visible running from the costal arch to about half-way between the edge of the left rectus and the midline. A notch may be felt between the two portions of the organ, and a bubbling and sizzling may be heard at that region as

PLATE LXVIII.



Hour-glass contraction of the stomach. The constriction from the fundic side just permitted the passage of the index and middle fingers; from the outer side, only the index finger. The specimen is stuffed with curled hair to give it shape. *A*, Cardia. *B*, Fundus. *C*, Spleen. *D*, Constriction. *E*, Pylorus. *F*, Duodenum.



the food passes from the cardiac portion into the pylorus. Patients sometimes describe sensations that correspond with this.

Examination by means of the stomach-tube often gives valuable suggestions. A return of stomach contents may occur, and after it is supposed that the organ is empty a regurgitation from the pyloric end takes place through the stenosis with the advent of an added supply of chyme. The first specimen is usually like an ordinary test-meal, acid in reaction with possibly some remnants from former meals, while the second is liable to be foul and evil-smelling and of low acidity. Moynihan has compiled the following set of symptoms: First, in lavage of the stomach, all of the fluid fails to return, some, which is in the secondary pouch, being apparently lost (Woelfer's first sign); second, after lavage has apparently thoroughly cleansed the stomach, more chyme appears, probably foul-smelling, the washings being again dirty (Woelfer's second sign), or the same may be found on withdrawing the tube after washing the stomach clean and then passing it again; third, the sign of paradoxical dilatation (Jaworski), which consists in the succussion splash on palpitation after apparent removal of all of the contents, and due to fluid being isolated in the pyloric end and thus impossible to obtain; fourth, after percussing out the stomach and thereafter distending it, a change in the position of the distention tumor. While the first two of these may give reliable results in the diagnosis of a case, it must not be forgotten that no contraction may exist and still these be obtained. Not infrequently the presence of a stomach-tube within the stomach and the process of lavage may contract the organ so that at the end of lavage a dirty liquid will follow the clear one. Also, on a few occasions, I have cleansed the stomach and at the end met with chyme that had regurgitated into the stomach from the duodenum. Usually, however, during the process of lavage the flow is the other way and some of the washings are lost in the intestine.

The one method of examination *par excellence* for diagnosing these conditions is resorting to the X-rays. In suspicious cases the morning stomach should always be washed before the drinking of the bismuth mixture. After this about twenty minutes should be allowed before the exposure is made so as to allow the bismuth to pass into the Pyloric pouch. The plate should be made with the patient standing, or prone with the abdomen down. The gastroscope may serve of value in some of these cases, although a good radiographic examination is usually sufficient for diagnosis.

**Persistent Excess of Secretion.**—It has already been mentioned that a number of cases that clinically appear to be those of gastrosuccorrhea are instances of ulcer more or less healed. Whether in these

conditions the secretion is increased as an effect of the ulcer on the organ, or had existed before the development of the ulcer and had persisted, is always difficult to decide. As cases of ulcer exist with a normal or subsecretion and as gastrosuccorrhea often exists without ulcer, it is reasonable to infer that ulcer is not such a potent factor in raising the status of secretion as was formerly supposed. That the combination of the two commonly exists and that there is a connection between hyper-acidity causing ulcer there is no doubt, but I believe that ulcer causing hypersecretion does not occur unless stagnation from the ulcer exists. In other words, I believe that resulting pylorospasm, contraction of cicatrices, and the binding down of adhesions cause an interference with the proper emptying of the organ, which results in condensation of the acid content. Naturally, when a history of past ulcer is obtained in the presence of a gastrosuccorrhea the above conditions should immediately be thought of, and these are cases often met with in practice. In my experience, a history of ulcer is rarely obtained, so that a diagnosis of gastrosuccorrhea is the only one that could be made. This is particularly true in cases seen early. It remains then to be demonstrated as these cases work out under treatment whether or not a post-ulcer condition is present in any individual case. Those that clear up after a time and remain well for months on a simple régime evidently are dietetic in nature. On the other hand, if they do not clear up and gastrosuccorrhea persists, the possibility of ulcer should be thought of. The closest observation is then necessary to arrive at a diagnosis, and all evidence pointing to the diagnosis of ulcer should be taken into consideration in subsequent examinations for the purpose of confirming or eliminating ulcer. The extraction of mixed meals at varying hours after ingestion and the observance of the gas results from simple meals may give most important clues. These, together with those mentioned under Ulcer and the X-ray examinations, have served well in diagnosing many of such cases, although a number remain obscure. In these, resort must be had to surgery, both for diagnosis and for relief, and possibly the performing of a gastro-enterostomy (which is the most efficient way to relieve the subjective symptoms of persistent secretion following ulcer). The therapeutic use of the X-ray may be employed before resorting to operation.

**Persistent Irritable Stomach.**—In practice these are also of two kinds: first, the persistent gastralgia that follows ulcer, and, second, a persistent gastralgia for which no cause can be assigned and which does not respond to proper measures of treatment. Essentially, gastralgia is a condition with a cause, is easily and successfully treated, and does not persist for great lengths of time. When such symptoms as pain, more or less vomiting and hyperesthesia persist after an ulcer, the

diagnosis is easy. But when these symptoms develop and persist and states of excess of secretions or the corporal neurological condition can be ruled out, the differential diagnosis is always difficult. The therapeutic use of the X-rays will no doubt serve to detect a few of them, because true ulcer cases usually improve on this treatment.

**Erosions of Vessels.**—Following the repair of an ulcer, a corrosion of the margins or autodigestion of the central portions of the cicatrix may occur with bleeding. The above title refers particularly to these, and does not deal with latent or chronic ulcer or malignant degenerations in which more or less hemorrhage usually occurs. Thus it is, that the conditions referred to are those that follow an acute ulcer, either within a short time or at a late interval. Usually when an acute ulcer is healed, latent hemorrhage is not observed. But there are not a few instances in which, because of incomplete repair in the first instance or the development of the conditions mentioned above after it, that hemorrhage may be met with. For this reason, it is advisable to make gastric and fecal analyses in all cases of acute ulcers during the first year after apparent recovery so as to note if this adventitious condition is present. I personally believe that a persistent high stomach secretion is the main factor in the production of intercurrent bleeding, because it has been my observation at autopsy that a hemorrhagic or new ulcerated area at the margin of an old scar is not uncommon. Possibly added to this in its production is the stiffness and inelasticity of an old cicatrix, which, with the soft glandularis bordering it, and the motility of the organ keeping up more or less of a bending motion at that point, a dissolution of tissue takes place.

Manifestly, the symptom of importance is hemorrhage, which in extent may be anything from a copious hemorrhage when a large vessel is opened to the subtle form which is small in amount but lasting longer. These patients may give no direct symptoms at all or may have more or less gastric distress. However, when the hemorrhage has been continuous, the symptoms of anemia, with loss of weight develop and may not respond to or remain permanent after treatment directed to the general health. The conditions are important for the reason that upon such scars carcinomatous degeneration is liable to occur. In a general way, it may be said that ulcers which cause profuse hemorrhage are often the ones that are most readily cured by medical means.

**Chronic Ulcer.**—While from a clinical standpoint it serves to no great purpose to separate the acute from the chronic forms of ulcer, still, a distinction between the two forms exists. Up to the present time all conditions following acute ulcer have been classed as chronic ulcers. This, in my opinion, is confusing because there is a type of ulcer which

possesses anatomical features distinct from the acute ulcer, and differs from it in its clinical course in the way that at best it shows but little disposition to healing. Such ulcers are usually irregular in shape, presenting a shelved or terraced formation, and in the beginning are soft, but which in the course of time usually display more or less connective-tissue deposit. This is particularly the type of ulcer which is liable to undergo carcinomatous degeneration with the production of the clinical entity designated as *ulcus carcinomatosum*.

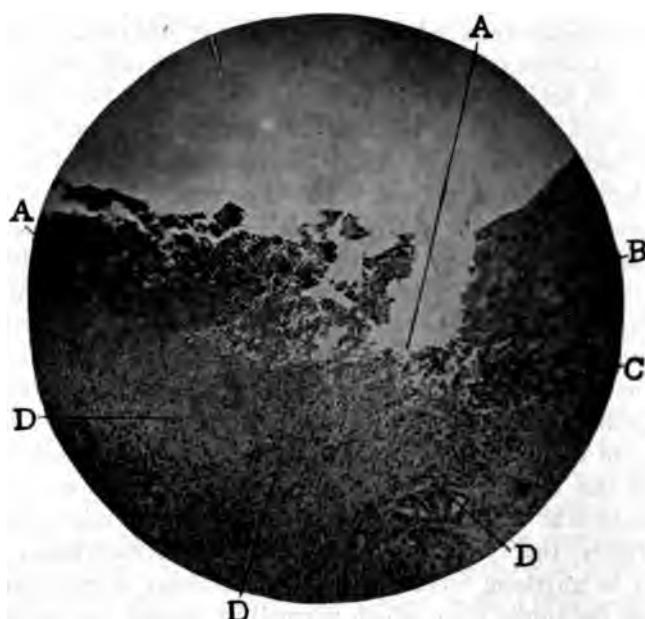


Fig. 116.—Photomicrograph of a chronic ulcer of the stomach. *A*, *A*, Ulcer pit filled with detritus and cells. *B*, Granulative tissue. *C*, Remains of a few gastric tubules which beyond the granulative tissue were found quite normal. *D*, *D*, *D*, Thickened and infiltrated submucosa.  $\times 84$ .

As a rule, there are no distinctive clinical features to this type of ulcer excepting that the symptoms of ulcer persist over a long course of time. In the beginning it is usually possible to conclude whether the ulcer symptoms present are due to the acute punched-out ulcer or the chronic form. In the presence of pains, nausea, vomiting, gastric distress, hematemesis, anemia, emaciation, etc., persisting in the face of all treatment the occurrence of the latter type of lesion should be thought of. These cases are usually met with in those well on in middle life, and, in my experience more frequently in men than in

PLATE LXIX.



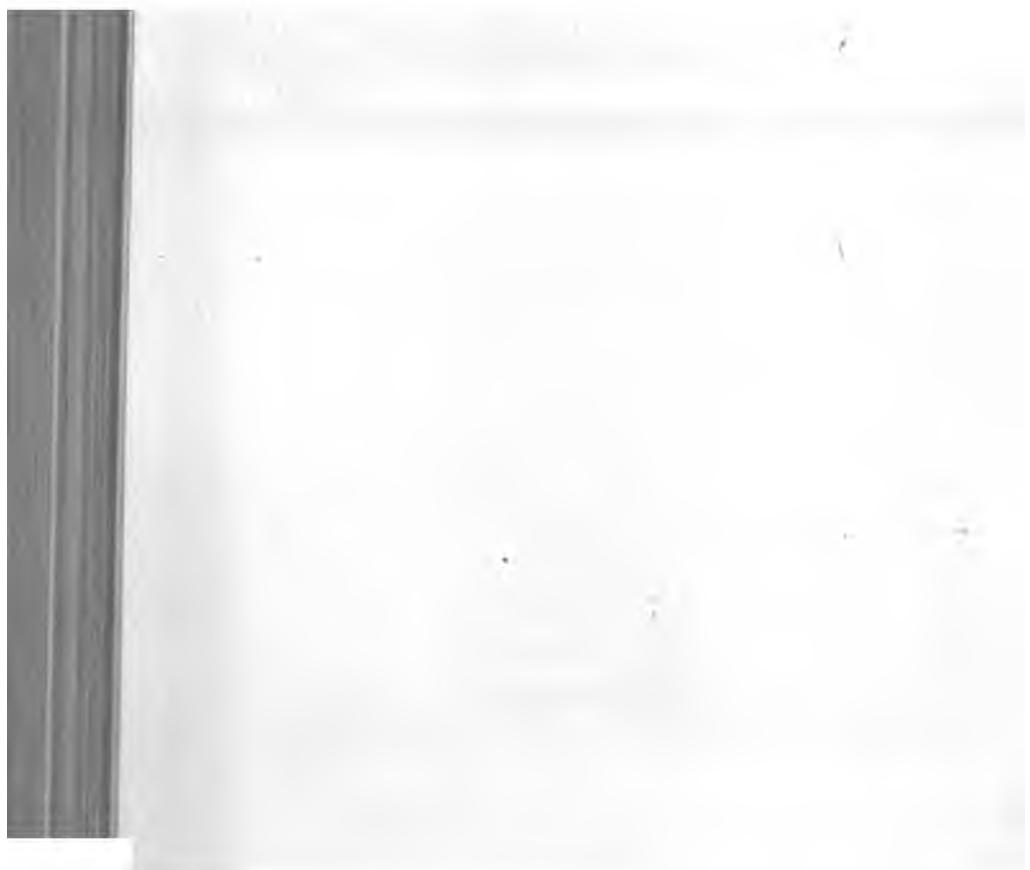
Old cicatrix in the stomach, the result of an acute ulcer which gave beginning symptoms some years before. Note the hard, contracted and raised ridge of scar tissue, in the center of which are seen areas of necrosis due to strangulation of the circulation, caused by the contraction of the fibrous tissue, and the digestion of same by the stomach secretions. To the right and left of the ridge are seen fanlike radiations of scar tissue over the free surface of the organ. The contraction of this scar was very evident on the outside of the stomach before it was opened for examination. It is evident that upon an existing formation like this a malignant growth (in the course of time) could make its beginning. (Actual size of the specimen.)

those who present the evidences of general arterial or merely arterial sclerosis. Such ulcers also complications of perforation, hemorrhage, perigastritis, stenosis of an orifice and other

or latent ulcers the cases of post-operative correct, although there is a addition to the chronic form type. This is most logically an ulcer for a great length of time in the intensity of symptoms suggesting its location in the stomach or duodenum. In the course of time connective-tissue deposit takes place under it to form a gastric ulcer—and the ulcer cavity is closed by this a more or less crater-like depression persists. They manifest their presence by any classical symptoms, except those of chronic distress and X-ray findings. It is due mostly to the ulcer that interest has awakened in the surgery of ulcer, the cases have been diagnosed by internists and are readily and best treated by surgery.

**Matous Degeneration.**—The possibility of this condition suggested by Cruveilhier in 1835, noted by Rokitansky in 1840, the first series of cases were analyzed by Dittrich in 1848. The author observed that in 166 cases of cancer of the stomach, 13 of ulcer were present in 8, and in 2 the malignant disease was at the very edge of the ulcer. Since that time a number of more advanced statistics proving the connection between the two remained for Graham, working at Mayo's clinic, to show that his figures were much too low, and that ulcer was probably a factor in the production of cancer in 61 per cent. of cases of disease.

It is essential to recall that the pylorus and lesser curvature are the best sites of both ulcer and malignant disease, and that these locations are subjected to more or less constant irritation. While arguments have been brought to bear upon the role of mucus or other forms of local irritation not being an exciting factor in the development of malignant disease, it is difficult for one to feel otherwise than that these are most important factors in all organs. Upon erosions and small-sized ulcers at the site of a cicatrix, or as a result of the gastric juice digesting away the remains of the contracting scar and the development of irritant neoplastic cellular elements in the cicatrix, a carcinoma-



women, and in those who present the evidences of general arterial change of senility—namely arterial sclerosis. Such ulcers also commonly present the complications of perforation, hemorrhage, perigastritis with adhesions or abscess, stenosis of an orifice and other deformities of the organ.

Many surgeons include as chronic or latent ulcers the cases of post-ulcer conditions mentioned. This is not correct, although there is a type of ulcer in the middle-aged which, in addition to the chronic form mentioned, is practically chronic in type. This is most logically an ulcer of some size which had existed for a great length of time in the acute stage without giving an intensity of symptoms suggesting its presence, which may be in the stomach or duodenum. In the course of time, an immense degree of connective-tissue deposit takes place under it—particularly in the gastric ulcer—and the ulcer cavity is closed by this thickening, although more or less crater-like depression persists. They may then not manifest their presence by any classical symptoms, excepting a history of chronic distress and X-ray findings. It is due mostly to this type of ulcer that interest has awakened in the surgery of ulcer, for few of the cases have been diagnosed by internists and are readily diagnosed and best treated by surgery.

**Carcinomatous Degeneration.**—The possibility of this condition was first suggested by Cruveilhier in 1835, noted by Rokitansky in 1839, and the first series of cases were analyzed by Dittrich in 1848. The latter author observed that in 166 cases of cancer of the stomach, the cicatrices of ulcer were present in 8, and in 2 the malignant disease began from the very edge of the ulcer. Since that time a number of observers have advanced statistics proving the connection between the two, but it remained for Graham, working at Mayo's clinic, to show that the prior figures were much too low, and that ulcer was probably a strong factor in the production of cancer in 61 per cent. of cases of malignant disease.

It is essential to recall that the pylorus and lesser curvature are the commonest sites of both ulcer and malignant disease, and that scars in these locations are subjected to more or less constant or intermittent irritation. While arguments have been brought to bear against trauma or other forms of local irritation not being an exciting cause for the development of malignant disease, it is difficult for one in practice to feel otherwise than that these are most important factors in cancer of all organs. Upon erosions and small-sized ulcers at the edge of the cicatrix, or as a result of the gastric juice digesting away central portions of the contracting scar and the development of irritation upon the neoplastic cellular elements in the cicatrix, a carcinoma-

tous degeneration may begin in susceptible persons which soon spreads beyond the confines of the ulcer area. In the beginning, such ulcers usually possess but little in their appearance to suggest the presence of malignancy, and the aid of the microscope is necessary to determine this. Such ulcers may resemble the chronic type, although occasionally the edges are rounded and the entire ulcer much stiffer and harder on palpation. In such instances perigastric adhesions with any of the surrounding organs or enlarged lymph nodes nearby may be found.

The early diagnosis of these cases is exceedingly difficult and may be quite impossible. In my experience the cases are clinically met with in one of these ways: first, the case that gives a history of at some time having had an ulcer, and in which the diagnosis of any of the aforementioned post-ulcer conditions comes up; second, the case which clinically represents a chronic ulcer that has continued over a space of time and slowly and progressively are developed the symptoms of emaciation, anemia, more persistent vomiting, and the appearance and increase in quantity of lactic acid with possibly a few Boas-Oppler bacilli also present, and, last, the late cancer cases in which the diagnosis of malignant disease is simple. Considering the difference in the gastric analyses between cases of distinct acute ulcer and cancer, it is plain that when the malignant process has just begun or is rather sharply confined to the ulcer area, the diagnosis is difficult. It is important, however, to remember that as the malignant process advances such stomachs are liable to decline in acid-enzymotic secretion with the occurrence of lactic acid and the organisms and more steady bleeding. These cases may for a time continue at a steady weight (particularly when on the fluid albuminous foods) even though cachexia gradually develops.

But there always comes a time when a loss of weight begins which is beyond what one might account for in ulcer, and when once started it is usually progressive. More or less pain is generally present from the beginning, but this is peculiar in that it is not so liable to be as definitely associated with the ingestion of foods as in ulcer, and is more constant in a low degree than it is in cancer. I have observed in several instances, and I feel that it is a practical point, that a patient with ulcer that persists with all of the ulcer symptoms, and then states that he has fewer of the sharp pains than previously, is likely to have malignant degeneration. Such cases also may at first have a sharply localized area of tenderness (ulcer), which subsequently becomes less acute, but more diffuse. The onset of gastrectasia should also be closely watched, and, most important of all, the general condition of the patient. In these ways some of the cases can be diagnosed, but, as surgery is indicated in

all of the benign post-acute ulcer sequels, in chronic ulcer, and in malignant degeneration, resort to operation is, after all, the best and safest means to arrive at diagnosis. In the predicament of indecision that usually assails one in these conditions, and the great dangers of temporizing until too late, it is indeed a blessing that exploratory incision under the modern methods is such a safe, simple, and valuable diagnostic procedure. The matter should be placed squarely before the patient, but, of course, not before all medical methods of diagnosis have been exhausted. The

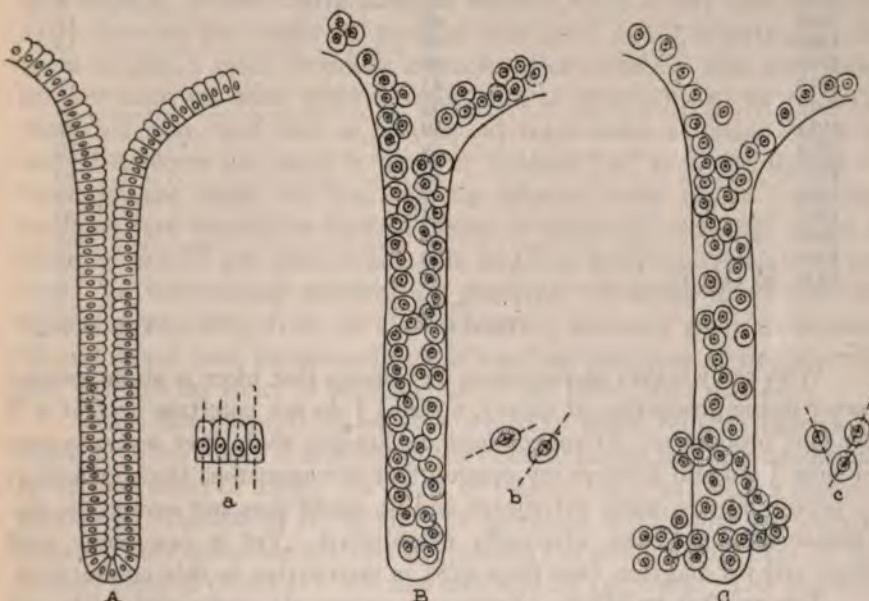


Fig. 117.—Diagrams of the cytological pictures found in the mucosa of chronic gastric ulcers. *A*, the normal gastric tubule with columnar epithelium, the long axes of which are parallel. (*a*), the individual cells lining a normal gastric tubule; the nuclei of the cells are about one-third the volume of the whole cell. *B*, a gastric tubule found in the mucosa of some chronic gastric ulcers; the columnar cells are replaced by ovoidal or spheroidal cells containing nucleoli; the long axes of the cells are not parallel; the nuclei are about one-half the volume of the cells (*a*) ; *C*, a gastric tubule sometimes found in the mucosa of chronic gastric ulcer. the cells are similar if not identical with the cells in tubule *B* but they are also found in the stroma. (MacCarthy.)

responsibility of the rejection or adoption of exploratory incision is then upon the patient, and we have done our duty. Intelligent persons usually respond to the advice; the ignorant and those who lack in courage usually require more suffering and explanation to bring this about. It is in influencing the latter that most of the discouragements are met with, and

the more direct and pointed the advice and the less the arguments, the more willing ones there will be to pursue the proper course.

In the studies of chronic gastric ulcer and gastric carcinoma MacCarthy<sup>6a</sup> presented the following statistics from the Mayo Clinic of the frequency of occurrence of the two:—

	<i>Carcinomatous Ulcers</i>	<i>Simple Chronic Ulcers</i>
1904	1	
1905	36	4
1906	29	10
1907	27	8
1908	42	13
1909	45	13
1910	47	21
1911	45	17
1912	45	32
1913	59	37
1914	68	39
1915	70	40
1916	49	39
1917	84	60
1918	62	61
1919	105	52
1920 (to Oct. 1)	84	61
Total	895	507

With the workers in this clinic he believes that ulcer is an important factor in the production of cancer, a belief I do not entertain beyond a 5 per cent. proportion. From a clinical and autopsy study over several years of time I am still fixed in my opinion that carcinomatous transformation of peptic ulcer is rather infrequent and no doubt does not exceed the incidence of 5 per cent. originally established. Yet it can occur and MacCarthy's diagram (see page 625) is instructive in this connection.

**Tetany Due to Ulcer.**—Tetany is commonly associated with old ulcers in which dilatation has occurred. This is seen in all grades from slight irritability of certain peripheral nerves with paresthesias—usually those of the face or of the extremities—to marked and steady seizures accompanied with coma and death. It usually occurs in pyloric stenosis of the benign type, but may be present in malignant disease. As to whether it is due to deficiency of water in the organism, to a reflex irritation of the nerve center from the irritated nerves of the gastric mucosa, or as a consequence of an intoxication of the organism by abnormal products of metabolism in the diseased gastrointestinal canal is still a mooted question. But it can occur as a sequel to ulcer, and has been reported by Albu to be the cause of death in 31 out of 40 cases. The symptoms are those of gastric stagnation and dilatation of a chronic type.

**THE COURSE, DURATION AND PROGNOSIS OF GASTRIC AND DUODENAL ULCER.**

The statistics pertaining to the cure of acute ulcer conditions can only be formed from the medical standpoint and only be gathered after at least one year has followed the termination of treatment. The figures advanced by surgeons show altogether too high a number of unsuccessful results of medical treatment in so far as the acute ulcer and erosions are concerned, and deal mostly with the complications and sequels. Leube's early statistics claimed 50 to 75 per cent. of cures after four to six weeks of medical treatment, and Lenhardt's results seem to give a more favorable outlook. Remembering that only about 25 per cent. of ulcer cases present clinical symptoms so as to make diagnosis easy, and that at autopsy at least twice as many scars as unhealed ulcers are seen, it must be evident that even the figures of Lenhardt are much too low. In my opinion, acute ulcers (including erosions) are curable by medical means or occur by no special means at all in at least 95 per cent. of all cases, and it is from the remaining 5 per cent. that the surgical statistics are gathered. It seems to me that the figures of mortality from all kinds of ulcers variously given as between 10 and 20 per cent. pertain only to the most serious types of this disorder and still fall far short of including all of the ulcer cases that exist.

From the surgical standpoint we have some reliable figures on hand as to results of treatment of the complications and late conditions in serious cases of ulcer. In these, of course, the results from medical treatment established at the time of operation were poor, particularly because they comprise the small percentage of about 25 per cent. of the plainly clinical ulcers that are not followed by recovery. The question that surgeons advance to internists, "How can you determine whether an ulcer is healed and be sure that no complications exist or sequels may occur?" is, of course, well taken, and quite impossible to answer satisfactorily so as to cover the full breadth of the subject. There are so many varieties of these conditions, the possibility of sequels must always be thought of, and such a difference in treatments and ability and time for observation with different physicians, that figures which would represent cure with one might be quite worthless to another. We can only say that a case which ran the clinical course of ulcer, or, without these, was diagnosed by medical means, in which a full return to health took place, and persisted for one year, is logically a cure, but that even in a very small percentage of these surgery may at some future time be indicated.

As loss of tissue in the human body is replaced by a cicatrix (excepting in some instances of nerve sections), this formation is the

result of acute ulcers. The chronic forms of ulcer do not show such a disposition to scar-tissue repair as do the acute ones, and usually remain more or less open or become thickened. The adventitious conditions resulting are essentially chronic, and malignant degeneration is progressive to fatality unless operated upon in time. Excepting in overwhelming hemorrhage when a large vessel is opened, the intermittent hemorrhages are acute and liable to recovery, and the continuous forms chronic and usually require surgery. Ulcers which give distinct clinical symptoms are (unless early perforation occurs) medical cases, and when properly treated tend to complete recovery in at least 75 per cent. of the cases; the remainder that do not are always surgical.

The prognosis of acute ulcer depends upon each individual case. Only according to the depth, extent, location, and character of the lesion, the careful and continued handling of the case in the first instance when the diagnosis was made, and the willingness of the patient to follow directions and to remain under observation for some months, can the prognosis be established. We should, excepting possibly in the successfully handled mild or moderate case, never be too optimistic. In the severer ones it is wiser to be conservative and always watchful, for there is no "always or never" in ulcer.

#### TREATMENT OF GASTRIC AND DUODENAL ULCER.

**Prophylactic.**—This may be divided into those methods that have to do with preventing the occurrence of ulcer, and those which have to do with minimizing the danger of return or the development of the post-ulcer conditions; both of these, however, will be presented together, since there is nothing particular to either.

The most important matter is the subject of excess of secretion. In these the treatment should be as outlined in Chapter XXIX. In addition, all matters pertaining to the general state of health and nervous system should receive attention. Anemia should be corrected by a full diet and the use of the hematinic tonics, and states of debility and subnutrition should be cared for by high caloric feedings and the employment of supplemental meals of a fluid albuminous character. Every effort should be made to decrease the stomach secretion and increase the general state of health, and in the latter the hygienic measures often offer substantial aids.

When the diagnosis of ulcer has once been made or strongly suggested, the patient should be put to bed, and the strictest discipline in the way of complete rest, dieting, medicine and hygiene insisted upon. In this way the case can be more satisfactorily controlled, and the

Results of medical treatment are better. Even in erosions, at least three weeks in bed should be insisted upon and preferably four. Failures in medical treatment come from indifference or incomplete discipline, and by its strict observance the dangers of hemorrhage and perforation are minimized. After this, the transition from rest in bed to walking about should be gradual and spread over two weeks longer. In a successful case that is without symptoms, a return to the ordinary fare can then be begun, although certain of the irritating foods and foods in quantities should be interdicted for a length of time. As regards diet there are certain rules applicable to all cases. Coarse vegetables and cereals, highly seasoned foods, made-up dishes, hashes, salted and preserved meats and fish, and soups made of meat should be excluded. Preserved fruits, pickles, fresh berries or vegetables with seeds and also nuts are dangerous. As regards beverages, beers, ales, wines and liquors of all sorts, as well as tea and coffee should not be drunk. Gruels, milk soups and purées, and other foods cooked with milk are useful. Water, milk, Vichy and cocoa are the best fluids. White bread may be eaten. Tender beef, lamb, chicken or fowl and fresh fish may be taken once a day, but advice should be given that these must be roasted or broiled, and, after being finely cut on the plate, should be swallowed only after thorough mastication. Eggs in any form with but little salt may be taken as often as desired. The cereals and vegetables should be well cooked, and potatoes and other tuberous vegetables mashed before eating.

The evening meal should be of fluid or semifluid foods or solid foods finely comminuted, the quantity at each time being small, and the amount of seasoning as low as possible, with the taking of supplemental meals of the fluid albuminous foods in the midmeal period and before retiring. The foods taken should not be too hot or too cold. In the first month or two when patients are on a mixed diet rest for one or two hours after meals should be insisted upon and also the avoidance of all business and irritating topics of conversation. If a hyperacidity persists or recurs after a mixed diet has been established, bismuth subcarbonate, the mineral alkalies, plain Vichy water, the oils, or atropine should be given. The bowels should be moved with Carlsbad salts, magnesia hydrate, or by enema, never by the other purgatives—not even cascara sagrada—and no pills or hard tablets should be taken. If patients can afford it, a sojourn in the country, or a course of treatment at Carlsbad, Vichy, or Ems should be advised. Beginning about two months after the conclusion of active treatment and at regular intervals during the first year, gastric analyses should be made and the feces examined for blood. If the acidity increases, or blood appears in the

stomach contents or feces, or gastric distress ensues, the case should be more rigidly treated, and perhaps again put to bed for a week or two. If gall-stones or an appendicitis is present, operation should be advised and insisted upon.

**Dietetic.**—A controversy has raged in recent years as to the best plan of diet to employ in the treatment of acute ulcers in respect to whether this should be one of scant or liberal fare. The fact of it is that the stomach and general conditions of the body are met with so differently in different cases that no one rule is applicable to all cases. One patient will do best on early and rather full feeding as recommended by Lenhartz, and another case becomes distinctly worse until complete rest of gastric activity has been carried out for several days as practised by von Leube. In so far as the stomach is concerned, it seems that results depend upon the elements of gastric and pyloric spasm, age of the ulcer, amount of bleeding and vomiting, and the general excitability of the organ. When these symptoms predominate rectal feedings and only very small quantities of food by mouth should be employed until the symptoms abate. If the case begins or becomes compatible with better feeding, the patient should be fed accordingly; if made worse by feeding, a severe modification in the quantity is advisable, or a few days' abstinence from mouth feeding should be instituted. As a rule, it is better to adopt von Leube's method for the first few days, and Lenhartz's after this until the termination of the four weeks of treatment. Less severe cases occur in which the Lenhartz method of feeding should be started in the beginning of treatment, and also more severe cases in which the Leube principles of feeding are necessary for a considerable time.

There are several matters pertaining to the two dietetic methods of the first few days that should be mentioned. The first is, that if resort to mouth feeding or to a fuller fare is long delayed after the use of the rectal enemas a distention of the stomach with a sudden increase in acidity is liable to occur and these may precipitate vomiting and directly or indirectly prevent the healing of the ulcer. The second is that, because of the nature and quantities of food, the Lenhartz feeding is quite likely to increase or maintain the excessive acidity of the gastric juice, and in this way a cure of the ulcer is wrought, but a high status of acid gastric secretion is left, which, as was mentioned before, militates against prevention of a recurrence or a better condition of the stomach after the ulcer has healed.

The dietetic treatment inaugurated by von Leube and von Ziemsen is rest in bed, and nutrition by the rectum or by food which burdens the stomach as little as possible. The modification by Ewald is described by him as follows: "For the first three days absolutely no

Food is to be administered by mouth, but a nutritive enema is given three times daily; subsequently, besides the enemata, milk or milk in flour soup, in teaspoonful doses, or bland pigeon or chicken broth. The milk, on account of its fine floccular coagulation, has some peginin added. If this diet is well borne, it is added to in a manner soon to be described; otherwise, absolute rectal nutrition is again instituted. If no pain follows the careful administration of milk, we may permit somewhat larger quantities (up to a flat plateful, *i.e.*, about 180 cubic centimeters), leguminous flour soup, then legumes; later pappy food made of chestnuts, sago, tapioca, Kufeke's flour, hygiama and others, and later small quantities of meat. Among nutritive substances cows' milk takes first place; it was first advised for this purpose by Cruveilhier. It is suitable because it contains all of the nutritive elements in solution, that is, finely subdivided, is free from irritating substances, because the acid is neutralized, and because the coagula which form from the action of the gastric juice remain soft. The patient, however, must drink it very slowly and lukewarm. To prevent the flocculent coagulation of the milk, and the irritation of the ulcerative surfaces due to this, I now add peginin (lab-ferment), which produces a very fine flocculent coagulation. Besides pigeon or veal soups, the yolk of an egg, and beaten-up egg albumin, pulverized meat or leguminous soups may perhaps be given. We must limit ourselves to these foods until the severe symptoms have disappeared. In the third week a food richer than this, both quantitatively and qualitatively, is permissible, and we should then carefully try food of somewhat greater consistence, such as scraped raw ham, raw or very soft boiled eggs, scraped venison or breasts of fowl, rolls or zwieback softened in cocoa, but milk is always preferable, and we should always be ready to return to a simpler diet as soon as the symptoms, or even pains, appear." It will be noted that this diet has as its main feature stomach rest, and that no particular effort is made to supply caloric values equal to the maintenance of nutrition or to encourage the repair process of the ulcer. The diet of Ewald may be considered as a conservative and rational combination of well-tried methods. Arguing for its use in the preference to that advised by Lenhartz, he reports to have had but 4.8 per cent. of hemorrhage after the thorough institution of treatment by limited feeding; whereas, Lenhartz, in 201 cases, had 5.4 per cent. of hemorrhage.

Starting from the fact that hyperchlorhydria, chlorosis and anemia frequently develop in the course of ulcer, Lenhartz has advised the use of quite a different dietetic treatment. Even in cases of hemorrhage and severe symptoms this author permits his patients from the start to take concentrated foods rich in albumin. Among the results that he

has reported are that in 60 cases treated by the diet (with rest in bed, applications of ice, 1 or 2 grams of bismuth daily, and, perhaps, iron with arsenic) only 1 case proved fatal, 7 had relapsing hematemesis, and that the pains ceased almost immediately after the ingestion of food rich in albumin, and the patients recovering more rapidly than those on the more modified diet. Of these 60 patients, 25 were subsequently questioned and 18 (72 per cent.) were entirely free from symptoms. Although this number of cases is much too small to draw any very useful deductions, they still represent a slightly better figure than Leube first claimed (50 to 75 per cent.). Lambert gives the results of treatment according to the method of Lenhartz in eight cases, all of which were severe, as—"All of the patients were benefited by the treatment, and, except those with stenosis, all were cured. One of the cases recovered after distinct failure with the other treatment." He concludes as follows: "This series does not warrant the conclusion that the original claims of Lenhartz are correct; first, the cure is at least equally as efficient as the other method, and that it does not deplete the patient; second, the cure is more rapid as well as more certain; third, the vomiting and bleeding stop more quickly and relapse is less frequent than in the Leube cure; fourth, the pain ceases promptly and morphine is never needed; fifth, the food supply is sufficient throughout; sixth, it is possible to treat the anemia earlier with iron and arsenic than in the Leube cure; and seventh, it is possible for the patients to return to a full diet and to their usual occupation earlier than in the older cure." In my experience, in a general way, the Lenhartz diet is the best to employ—simply because the average case is not severe enough to call for stomach rest from foods.

The routine of the Lenhartz plan of feeding is as follows: Food is administered in small quantities at one-hour intervals. Slow mastication and slow eating are insisted upon, and these are accomplished by feeding the patient with teaspoonful amounts, and by not allowing him to feed himself during the first two weeks of the cure. Three or four weeks' rest in bed is insisted upon in each case. An icebag is applied to the epigastrium to relieve the pain, and bismuth subnitrate is administered internally for hemorrhage. The preparation of food used during the first weeks is as follows: The raw eggs are beaten up whole and iced. Both the milk and the eggs are placed in covered glass tumblers surrounded with cracked ice and kept at the bedside. The feeding spoon is also kept iced. The eggs and milk are administered in alternate feedings. Granulated sugar is added to the eggs on the third day. The raw, scraped beef, boiled rice, and zwieback are prepared in the usual manner.

The routine of administration is the following:—

<i>Day.</i>	<i>Eggs.</i>	<i>Milk.</i>	<i>Sugar.</i>	<i>Scraped Beef.</i>
1.	2 drams each dose. Total, 2 eggs.	4 drams each dose. Total, 6 oz.		
2.	3 drams per dose. Total, 3 eggs.	6 drams per dose. Total, 10 oz.		
3.	½ oz. per dose. Total, 4 eggs.	1 oz. per dose. Total, 12 oz.	20 grams added to eggs.	
4.	5 drams per dose. Total, 5 eggs.	1½ oz. per dose. Total, 1 pint.	Same.	
5.	6 drams per dose. Total, 6 eggs.	14 drams per dose. Total, 18 oz.	30 grams.	
6.	7 drams per dose. Total, 7 eggs.	2 oz. per dose. Total, 22 oz.	40 grams.	36 grams in 3 doses.
7.	4 drams per dose. Total, 4 eggs. Also 1 soft-boiled egg every 4 hours.	2 oz. per dose. Total, 26 oz.	40 grams.	70 grams with boiled rice; 100 grams in 3 doses.
8.	Same as above.	2½ oz. per dose. Total, 28 oz.	Same.	Same.
9.	Same as above.	3 oz. per dose. Total, 1 quart.	Same.	Beef, same; rice, 200 grams; zwie- back, 40 grams in 2 portions.
10.	Same as above.	Same.	Same.	Same.

Add chopped cooked chicken, 50 grams; or ham, 50 grams, and butter, 20 grams.

1-14. Interval of feeding made two hours. Milk given in 6-oz. doses, with ½ oz. of raw egg. Butter increased to 40 grams, and chicken or ham as above.

At a recent German congress of internal medicine, Lenhartz reported his results in 295 cases of gastric ulcer treated according to his principle of a more nourishing diet than that allowed by von Leube which has been a standard for so long. In 262 cases there had been a hemorrhage before the treatment was commenced, and in 33 the stool contained blood, but his total mortality was 2.3 per cent., and only 18 cases had hemorrhage after treatment was commenced. Making comparisons with Lenhartz's results, von Leube replies to Lenhartz maintaining that his thirty years of experience and especially the 627 cases of gastric ulcer in which he has applied his "rest cure" during the last eleven years have fully confirmed the advantages of his technique, while he sees possibilities of danger in following Lenhartz's directions. He reported that fully 90 per cent. of his patients were cured; 8.5 per cent. improved, and only 1 per cent. failed to benefit, while the mortality from hemorrhage was 0.3 per cent. He is convinced that the only way to induce the formation of the life-saving thrombus and thus check the tendency to hemorrhage is to keep the stomach absolutely at rest; the patient is kept in bed with a single dose of 30 drops of a 1 per thousand solution of adrenalin supplemented by bismuth, an icebag over the stomach, an injection of morphine to keep the stomach quiet (never for its pain-reducing properties) and complete abstinence from food by the mouth. Ingestion of egg or milk may bind the acid, but at the same time they stimulate the peristaltic movements of the stomach which it is the aim of treatment to avoid. After the stool has lost its admixture of blood, and

other signs show that the hemorrhage has been arrested, which is usually the case in two or three days, he cautiously commences a liquid diet in the course of one or two days. The patients may lose in weight at first, but they make it up and more by the end of the second week. He restrains from iron on principle, saying that ulcer patients do not seem to tolerate it well, and study of twenty-five cases on the liquid diet for two weeks did not show any special reduction in the hemoglobin. Laxatives must be strictly avoided. The four elements of his "rest cure" are the absolute rest in bed; one glass of tepid Carlsbad water twice a day, fasting, hot flaxseed poultices renewed every ten or fifteen minutes and applied continuously for twelve hours, at night a wet linen cloth being substituted. The special diet completes the course of treatment, and he emphasizes the fact that the combination of these four factors is indispensable for the best results, and that complete abstinence from food until the hemorrhage has been arrested is the only safe and commendable method.

As was mentioned before, the choice of the two methods of feeding depends altogether upon the intensity of the gastric symptoms and the general condition of the patient. In one, the Leube method is indicated; in another, the Lenhardt, and in still another, first the Leube and then the Lenhardt, or possibly the other way. No definite rules can be set down to meet all cases and the physician must choose for himself in each instance which is the best course to pursue. Formulas for the nutritive enemata will be found elsewhere. The occurrence of occult blood in the feces during the course of treatment and in the early days afterward usually requires transition to a more generous diet; but sometimes it is best stopped with strict feedings.

The diet suggested by Smithies<sup>7a</sup> especially in the bleeding and vomiting case is the following:—

Mouth feeding should not be initiated until all vomiting or retching have ceased and until chemical examination of the stool demonstrates an absence of blood. When mouth feeding is instituted, the diet should consist of warm liquid carbohydrate gruels (cream of wheat, farina, strained oatmeal, malted milk, etc.) and warm cream for a week. Care should be taken that at least 1500 calories of food are given daily. If after a week carbohydrate gruels are well borne, then a régime similar to the following may be instituted.

*Breakfast:*

- 1 pint of hot skimmed milk.
- 1 dish of thin cream of wheat, farina or strained oatmeal.
- 3 zwieback.

10.30 A.M.

- 1 pint of hot milk.
- 2 zwieback.

Noon:

Thin creamed soup made from all kinds of vegetables, but strained.

Crackers may be taken with soup. Oyster soup may be eaten.

Small amounts of mashed potatoes, 6 ounces of steak to chew, thin custard and 3 zwieback.

3.30 P.M.

- 1 pint of hot skimmed milk.
- 3 zwieback or graham crackers.

Evening Meal:

Creamed soups or cereal with hot milk.

- 1 very soft boiled egg.
- 3 zwieback.

Bedtime:

$\frac{1}{2}$  pint of hot skimmed milk and 2 zwieback.

By the end of six weeks after the hemorrhage, the patient should be ready to take general soft liquid diet with a limitation upon fats and proteids. Raw milk should be interdicted for as long as three months after the hemorrhage. It is usually poorly borne inasmuch as the tough casein clots remain for a long time in the stomach and act as stimulation to peristalsis and gastric secretion. They infrequently are productive of annoying distention, belching or vomiting. All milk should be parboiled and citrated—1 grain of sodium citrate to each ounce of milk.

Sippy<sup>7b</sup> has advanced a method of dietetic and medicinal treatment for ulcer based on the removal of the corrosion effects of gastric juice. This is done by frequent feedings and liberal use of alkalies. The patient remains in bed from three to four weeks. Quoting liberally from his article the following is offered:—

"Three ounces of a mixture of equal parts milk and cream are given every hour from 7 A.M. until 7 P.M. After two or three days soft eggs and well-cooked cereals are gradually added, until at the end of about ten days the patient is receiving approximately the following nourishment: 3 ounces of the milk and cream mixture every hour from 7 A.M. until 7 P.M. In addition, three soft eggs, one at a time, and 9 ounces of a cereal, 3 ounces at one feeding, may be given each day. The cereal is measured after it is prepared.

"Cream soups of various kinds, vegetable purées and other soft foods, may be substituted now and then, as desired. The total bulk at any one feeding while food is taken every hour should not exceed 6 ounces. Many of the feedings will not equal that quantity. The patient should be weighed. If desired, a sufficient quantity of food may be given to cause a gain of 2 or 3 pounds each week.

"A large variety of soft and palatable foods may be used, such as jellies, marmalades, custards, creams, etc. The basis of the diet, however, should be milk, cream, eggs, cereals and vegetable purées. Lean meat is not given during the period of accurate observation, since it interferes with the tests for occult blood in the stool and aspirated stomach contents.

"The acidity is more easily controlled by feeding every hour and giving the alkalies midway between feedings. The acidity may, however, be controlled by feeding every two, three and four hours. I have maintained complete control of the free hydrochloric acidity in several cases by feeding three times daily. In most cases, however, the plan of feeding every hour is best.

"The practice of maintaining an absolutely accurate control of the free hydrochloric acidity during the entire time that food and the accompanying secretion are present in the stomach has become thoroughly established. This requires the administration of varying quantities of alkalies, corresponding to individual cases. Also, in addition to giving an alkaline powder midway between feedings, the powders are continued every half hour after the last feeding, until 10 P.M. In all cases of pyloric obstruction from duodenal and pyloric ulcer it has been found advisable to empty the stomach of all remaining food and secretion at about 10:30 P.M., thus removing the stimulus to an excessive night secretion. In most cases a short time after treatment is begun the stomach will be found empty at that time. The management of excessive night secretion has already been described.

"Cases of stomach ulcer unassociated with stagnation of food and secretion are usually controlled by feeding every hour and giving a powder containing 10 grains each of heavy calcined magnesia and sodium bicarbonate, alternating with a powder containing 10 grains of bismuth subcarbonate and 20 or 30 grains of sodium bicarbonate, midway between feedings. Cases of pyloric and duodenal ulcer that have been associated with stagnation of food and secretion longer than two months almost invariably require larger quantities of alkalies.

"Heavy calcined magnesia has approximately four times the neutralizing power of sodium bicarbonate. Since its neutralizing effect is prolonged compared with that of sodium bicarbonate, and for other reasons, calcined magnesia should be used between as many feedings as possible. An uncomfortable diarrhea usually prevents its exclusive use as a neutralizer. Other stable alkalies similar in action to calcined magnesia are being carefully tested.

"In a few cases of duodenal ulcer with high grade obstruction it has required the equivalent of 100 grains of sodium bicarbonate every hour.

midway between feedings, and three doses with intervals of one-half hour after the last feeding, at 7 or 8 P.M., to neutralize all the free hydrochloric acidity.

"The average length of time that a patient with peptic ulcer should be under the accurate control and observation of the physician is about four weeks. During this period, if observations have been carefully and intelligently conducted, the finer points essential to a complete diagnosis of peptic ulcer, including such conditions and complications that may attend the ulcer, will have been determined, and the patient will have learned how to manage himself accurately. Thus the gratifying results to be obtained by the management advocated are secured.

"The non-obstructive type of gastric ulcer requires relatively little attention to details compared with the obstructive type of duodenal and pyloric ulcer. The dosage of alkali required to control the acidity is smaller, and it is seldom, if ever, necessary to remove the remaining food and secretion at bedtime.

"Ideal conditions for the healing of peptic ulcer are maintained when the aspirated stomach contents show absence of free hydrochloric acid during the entire time that food and the accompanying secretion are present in the stomach, and all excessive night secretion is controlled.

"Experience has shown that when the free acidity is found controlled late in the afternoon and just previous to taking the powders or feedings, the acidity is likely to be controlled at all other times during the feeding hours. It is not difficult to determine the amount of alkali required between feedings to control accurately all free acidity. If not controlled the first few days by giving the usual amount, then the dose is gradually increased until the acidity is regularly found controlled.

"It should be understood that the presence of free hydrochloric acid now and then for a few minutes each day does not seriously interfere with the healing of the ulcer. Such short periods during which corrosion of the ulcer may be possible are as nothing compared with the duration of corrosion to which duodenal and pyloric ulcers are subjected after gastro-enterostomy. In the ordinary surgical treatment of these conditions such ulcers are subjected to the corrosive action of the gastric juice during the whole period of normal stomach digestion, which occupies many hours each day. The majority of pyloric and duodenal ulcers treated by gastro-enterostomy show few symptoms after the operation, and such ulcers probably usually heal in the course of time, the same as the majority of the non-obstructive type of gastric ulcers usually heal without treatment. In either case, however, the conditions for healing are far from ideal.

"As will be more clearly stated later, the symptoms of pyloric and duodenal ulcer after gastro-enterostomy and the symptoms of the usual non-obstructive type of gastric ulcer without treatment are approximately the same. Other things being equal, the conditions for healing are approximately the same. Both are subjected to the same duration of gastric juice corrosion. The very great tendency for peptic ulcer to heal, if the hindrance to healing is removed to only a moderate degree, is responsible for the recoveries that occur when gastro-enterostomy is performed for an ulcer located at the outlet of the stomach, causing stagnation of food and secretion.

"While the symptoms may be controlled and healing accomplished in the majority of all cases of uncomplicated peptic ulcer by applying the usual or Leube type of medical management; while operative procedure successfully performed, such as gastro-enterostomy and pyloroplasty operations, may be infinitely superior to the Leube and other types of medical management in general use when applied to cases of pyloric obstruction, all types of medical and surgical treatment now in common use accomplish relatively little toward protecting the ulcer from gastric juice corrosion when compared with what may be easily, comfortably and safely accomplished by applying the accurate medical management which I have established and advocated.

"Pyloric obstruction due to spasm of the pylorus, resulting in the retention of food and secretion from one meal to the next during the daytime, and until 3 or 4 o'clock in the morning, and even until the next morning at breakfast-time, disappears at once under the influence of such management.

"Pyloric obstruction, even of the highest grade, and of long duration, as evidenced by the presence of vigorous peristaltic waves, showing through the abdominal wall, history of vomiting food eaten the day before for many months, the aspiration of food eaten twelve or more hours before, and the presence of abundant sarcinæ, often rapidly disappears, so that at the end of ten days' or two weeks' management, seven hours after the largest and coarsest kind of a motor meal is given the stomach is found empty.

"As unbelievable as it may seem, cases of duodenal ulcer recurrent for years, that have finally developed a high grade pyloric obstruction due to actual anatomic narrowing from indurated, infiltrated and edematous tissue, have yielded completely to the management."

Of late years the author has used the above method in uncomplicated cases and is quite partial to it. The case must be kept on after the fourth week only eggs, milk and cream, butter and bread allowed for a month or

longer and the alkalies should be kept up for the best part of several months.

**Author's Food and Medicinal Method.**—No claim for originality in any way is made for this because it really comprises the fasting of Ewald method, the hourly milk and cream feedings and alkaline powders of Sippy's, my own diet for working down of hydrochloric acid secretion and X-ray therapy, both of the latter advanced in 1910 and steadily employed since then. The method has been used on enough cases to convince the author that it possesses advantages worthy of consideration.

The treatment is begun with 24 to 48 hours absence of food by mouth. During this time are given a dose of calomel,  $\frac{1}{4}$  grain every fifteen minutes for eight doses and Carlsbad twelve hours after finishing, and at twelve-hour intervals during the fasting period. Cool, but iced, water is allowed to be drunk in sufficient quantities to allay thirst. Alkalies are administered from the beginning to neutralize the gastric juice secretion that may be present. These during the fasting period are of 10 grains each sodium bicarbonate and bismuth carbonate given every three hours and six doses given in twenty-four hours, there being an interval of six hours through the night.

*First Month.*—Three ounces of a mixture of equal parts of cream or milk are given every hour from 7 A.M. to 7 P.M. for three days (1835 calories), and the alkaline powders of soda bicarbonate and bismuth carbonate, and to keep the bowels open alternating powders of soda bicarbonate and calcined magnesia are given midway between the feedings. This corresponds to the first three days' method of Sippy, and represents about 1325 calories a day. On the evening of the second day of this feeding note is made if there is any free acid retention residual in the stomach. This is done usually at 11 P.M. by aspiration of the stomach contents with a fractional test-tube and noting the return, or by swallowing a gelatine capsule having an incision of string inclosed in the capsule impregnated with congo or dimethyl, and dried and withdrawn in fifteen minutes after being in the stomach. On the finding of a positive acid, the urine is tested and passed again in an hour and note is made of the reaction of the last specimen. If no acid is present in the stomach (even if the urine be slightly so) no alkalies are given through the night, throughout the next fifteen days of the bed treatment. Generally by this time the stomach is negative to acid and the urine also. If acid is met with in the stomach and urine also, alkalies are given at three-hour intervals throughout the night, for the remainder of the days in bed in quantities to keep the urine alkaline or neutral to litmus paper. Modifications

tion here depends upon the reaction of the urine, this being noted at the end of the day and before feeding is resumed in the morning.

On the sixth day from beginning the treatment, a mixture of eggs, cream and milk is given at hourly intervals. Soft eggs and cereals are not employed as Sippy advises, for the reason that whole eggs and especially cooked in any fashion cannot be accurately controlled in quantities. Cooked ones had better not be given, and no cereals should be given until after the bed treatment is terminated (somewhat and somehow they tend to diminish the best results accomplishable). The mixture I employ is the following:

	Amounts at Feeding	Milk	Cream	Eggs	Calories	Time	Number
6th to 9th day	3½ oz.	25 oz.	25 oz.	2	2050	hourly	13
9th to 12th day	4 oz.	22 oz.	34 oz.	3	2650	hourly	13
12th to 15th day	4½ oz.	20 oz.	44 oz.	4	3275	hourly	13

From the fifteenth to the twenty-first day the feedings are in ½ ounce quantities of equal parts of milk and cream. Four eggs in the day are allowed cooked in any soft way. At this time 40 grams of sugar are allowed, not in the form of saccharose (cane sugar) which stimulates acidity and tends to constipation, but as lactose, maltose, etc. The feedings at this time are extended to two-hour intervals and the milk and cream mixture on thickly buttered toast at two meals is allowed. (This represents 3450 calories a day). Effort is made in these six days to lengthen the interval of feedings so that on the twenty-first day meals of milk, cream, eggs, bread and butter and sugar and milk and cream are given at 8, 12, 4 and 8 o'clock with one or the other of the alkaline powders one hour after each of them, and a milk and cream feeding at 10, 2, 6 and 10 o'clock followed by a powder.

*Second Month.*—For the first month out of bed I do not allow soft or strained foods such as jellies, marmalades, vegetables or leguminous purées as Sippy advises. Instead patients are kept absolutely on the above four foods and the following which represents 3780 calories a day is strictly maintained. Such a diet is the following:

The diet is a temporary one and is to be continued until a change is made. The plan is not to partake of any solid foods whatsoever, and to take the foods that are suggested at regular intervals of four hours during the day, attention being paid that a strict regularity is preserved and that the foods are divided up rather evenly in quantity for each time.

A glass of plain fresh milk and perhaps a few crackers should always be taken between meals and before retiring, and an extra glass of milk during the night if there is distress in the stomach.

The diet consists essentially of only four foods, namely, eggs, fresh milk and cream, well cooked cereals, bread and crackers and nothing else in the food or fluid line (excepting plain water) should be taken.

The eggs may be eaten raw or cooked in any form, or may be taken in the milk. The milk may be warmed if desired, but should not be taken too hot or too cold. The "ten minute" modern breakfast foods or any form of oatmeal should not be eaten, the old-fashioned forms of ground corn, farina, rice, tapioca or sago, well cooked, being the best. The bread should not be too fresh (one day old), any of the sweetened or unsweetened crackers can be used and all forms of simple cake, providing there are no nuts, raisins, seeds or preserved fruits in it.

The total amount of food in one day should be—four eggs, one quart (4 tumblerfuls) of milk, one-quarter of a pound of fresh unsalted butter, or one-eighth of a pound of butter and an extra quart of milk, two rolls or four medium thick slices of white bread, one-quarter of a pound of baker's cake or crackers, one-half pint of fresh cream, and one-quarter of a pound of cereals.

On this four meal a day plan with the interval feedings I use 8 powders, each taken one hour after a feeding of any kind. During this first month out of bed the activities of the individual are restricted, this with the initial bed treatment taking 8 weeks.

*Third Month.*—After the eighth week the 8, 12, 4 and 8 o'clock meals are diversified with the following selections, plain milk (not fermented) being taken midway between the meals and alkaline powders, one hour after each feeding.

Purées or creamed soups (barley, rice, peas, beans, celery).

Gruels (flour, cracker, barley, indian meal, farina).

Plain crackers, baker's cake, pound cake, toast, rolls, jellies, rice, tapioca.

Ground or mashed vegetables.

Puddings, rice, tapioca, bread, cracker.

Custards, vanilla and chocolate, blanc mange, whips and soufflés.

Gelatines—flavored with any fruit or berry juice.

Plain ice cream—not too cold.

Malt—milk cocoa, cocoa, chocolate.

This is kept up to the fourth month when the following diet is prescribed and the powders changed to one kind which is a combination of the two kinds used before. The combination I most often use is the following:

Magnesia usta,

Bismuthi subcarbonatis,

Sodium bicarbonatum,

Sacharri lactis,

Fiat pulv. .... 15.0.

Sig.: Take a teaspoonful in water after meals.

The general plan of the diet is to take three moderate sized meals at regular intervals during the day, and to take supplemental meals of milk, re-enforced with

cream, cocoa and crackers between meals and before retiring. Altogether foods should be taken at least five times during the day.

All of the solid foods should be tender, cut very fine on the plate and thoroughly masticated before swallowing.

Olive oil may be taken before the main meal.

The foods permitted for the main meals are:

Beef, lamb and chicken, roasted or broiled and taken only once a day.

Fish, any kind and in any form excepting fried, taken once a day.

Eggs in any form, other than fried, and taken once a day.

Cereals (with the exception of oatmeal and shredded wheat biscuits) well cooked and taken with cream in the mornings.

Vegetables—any that are well cooked and mashed with the exception of green vegetables. May have the tubers, such as baked or well mashed white potatoes, squash, parsnips and turnips.

Desserts—any made of milk, cereals and jellies.

Do not take fruits, berries or nuts.

Butter, cream, milk and cereals and eggs still remain the main foods of the daily diet. If the symptoms become marked again these should be the main articles of the diet for a while, when the more general plan may be followed.

The best drink at the meals is Vichy Celestins or any alkaline water (Kalak Saratoga).

*After Sixth Month.*—At the end of six months a normal diet is employed. The following of what not to take is given to the patient.

Foods that will be especially injurious and must not be partaken of are:

One or two minute cooked breakfast foods.

The rough vegetables such as cabbage, sprouts, cauliflower, artichokes, asparagus, beets, celery, corn, cucumbers, kohl-rabi, onions and tomatoes..

Foods which contain pits, seeds or skins, or nuts.

Canned or smoked meats or fish.

Lobster, crab or shrimp.

Cheese of any kind excepting Philadelphia or Neufchatel.

Too much pastry, especially those kinds cooked in molten fat like doughnuts, fritters, etc.

Foods that are too sweet, such as jams, etc.

Fruits, cherries, cranberries, figs, grapes, muskmelons.

Coffee, strong tea, alcoholic and malt beverages are not allowed.

During the second month X-ray treatments are given to the stomach, these usually being six in number, given in five-day intervals. The patient is rayed on an empty stomach which contains 2 ounces of bismuth subcarbonate. The exposure at twenty-four inch distance is one minute, 5 to 10 milliamperes, five inch spark gap, 2 milliamperes of aluminum and a thickness of sole leather used as filters.

Occasionally some form of organic iron is taken by mouth or a ferruginous preparation by hypodermic method.

An addition to the therapy of gastric and duodenal ulcer made recently is the use of the duodenal method of alimentation. For this purpose either the Gross, Rehfuss, or Einhorn tube may be employed. The principle upon which this method of nutrition had been advanced is that foods could be delivered in the upper part of the digestive tract and not come in contact with the ulcer-bearing area. Time enough has elapsed for the enthusiasm of this method of treatment to have waned, for it is evident that the number of cures by this method is not even as good as the rest in bed and diets of Lenhartz or von Leube. More than that, it does not take into consideration the difference between the acute and chronic ulcers, for the truth is that acute ulcers are even more amenable to the older methods of treatment than they are by the duodenal method of feeding, and some of the chronic ulcers should be considered surgical when seen. After a rather consistent use of the duodenal method of feeding I have abandoned it for the reason that, however little acid there may be in the stomach, it is not bound by protein foods present in the organ. A point here is between having an indigestible rubber tube present in the stomach all of the time, which is a mechanical irritation, or the fluid foods, and it is rational that the latter is to be preferred. Further than that, in addition to such acid as is constantly being secreted in an ulcer case, the delivering of a quantity of fluid in the duodenum by means of the duodenal tube reflexly excites a higher acidity in the stomach, and, since there is no food there and free acid is an irritant, the method is not advisable. In a case of mine of gastric ulcer of seven months' standing in which the duodenal method of feeding was employed, the pains increased instead of diminishing, and the patient's general condition became decidedly worse. The tube was then removed and Lenhartz's diet instituted, after which a steady recovery took place. Following this case, the author made observations in two adults to see what effect the constant presence of the tube had upon the stomach. After these persons had the duodenal tube in for four days, fluoroscopic observations were made, and, comparing these with the fluoroscopic observations made before the tube had been worn, it was evident that the presence of the tube, drawing taut as it does against the lesser curvature, increased the motility of the stomach. Also test-meal extractions before and after showed that the running acidity was slightly increased, and, as was mentioned, also elevated after a meal had been passed through it. Now, since it is necessary to bind or neutralize the stomach acidities and maintain a neutrality by keeping the urine constantly alkaline, and because motility means peristaltic unrest and free acid are against repair of an

ulcer, I must discourage the employment of duodenal alimentation as a means of treatment.

**Medicinal Treatment.**—The most generally employed drug in the treatment of gastric ulcer is bismuth subcarbonate. The beneficial results from the use of the insoluble bismuth salts have been variously described, but it is most probable that they are wrought by their acting as a mechanical sedative in the way of inhibiting the secretion and motility by coating the mucosa and thus keeping the gastric contents away from direct contact with the glandularis and the ulcerated surface.

According to Thesen,<sup>10</sup> the usefulness of bismuth is ascribed to a disinfecting action on the ulcerated surface, and also to the possible fact that the bismuth albuminoes formed are taken up by the lymph and are carried into the lymphatics where they exert a direct curative action on the lymphangitis. However the benefits are obtained, cases do better when one of these salts has been used and also when the subgallate is used in hemorrhage and the subcarbonate in high acidity. By their use the pains are lessened, the vomiting and hemorrhage are controlled, and in a few days the stomach becomes generally more tolerant.

The best results from its employment are obtained when the dose is large and taken into the empty organ. At least two and often preferably more grams should be given at a time, either in plain boiled or in barley water. Some authors recommend the taking of only one large dose in the mornings, but, because in the average ulcer case the organ is quite emptied of bismuth in from four to six hours, it is best to give it in smaller quantities, 2 to 4 grams (30 to 60 grains) at about the above intervals. There is one drawback to its use that is occasionally observed and that is its constipating effects on the bowels, and this is particularly true of the subgallate. This, however, may be obviated to some extent by combining the bismuth with magnesia usta (as below), suspending it in olive oil, giving Carlsbad salts each morning, or using enemas.

R. Bismuthi subgallatis, subcarbonatis, or subnitratis,  
Magnessii oxidii ..... 40.0 3x  
Fiat pulv. no. x.

Sig.: Take one every five hours in barley-water.

To obviate the danger of nitrate poisoning such as may occur when the subnitrate salt is used in large doses over a continued time, it is best to employ the subcarbonate or subgallate in the first instance or substitute these for it in a few days. The administration should be steadily continued during the first two weeks of treatment and then in smaller doses for as long as may be indicated. For the treatment

of gastric ulcer I am not in favor of the Fleiner or the Cohnheim method for the reasons that the daily passing of the stomach tube is required in both, and that results from them are not any better than the Leube or Lenhartz treatments. Olive oil, however, used in Cohnheim's method, may be a valuable adjunct to the treatment in the way of relieving the pain, vomiting and pyloric spasm by holding in check the acid secretion and forming a protective coating to the ulcer. It may be given (drunk) in 1 or 2 ounce quantities and serves as a good vehicle for any of the bismuth salts. Many patients object to the taking of olive oil by mouth, declaring that it nauseates them; in these instances it may be used as Cohnheim suggests (run down through the stomach-tube), but not in the early days of treatment when the dangers of perforation and hemorrhage should always be remembered.

At the end of the first week, plain Carlsbad thermal water or still Vichy may be used as a drink. These may be given a wineglassful at a time and preferably at the room temperature. The Carlsbad salts may be used to relieve the constipation, and it is important to remember that this is about the only purgative salt that is tolerated by these stomachs, Epsom, Rochelle, and others being very likely to cause acute gastric distress. The dose is a teaspoonful in a glass of warm water drunk slowly early in the morning.

A drug of the greatest value in the treatment of acute ulcer is belladonna or its alkaloid atropine, preferably the first. It seems strange that a medicament which in its physiological action combines so many features of benefit should not have received more than a passing mention and consideration. Rather generally in the therapy of excessive gastric secretions its use is advised, and it often serves to good purpose as a symptomatic medicament. But even in these the beneficial results are never as marked as they are in ulcer. Quoting a recent article in which I drew special attention to its use in the treatment of gastric ulcer (Bassler<sup>11</sup>) the following may be repeated: "While the Lenhartz treatment possesses worthy advantages in the way of maintaining better general nutrition, and thereby indirectly favoring better repair of the ulcer, there is one factor in its use which has not received enough attention, and this is that in the larger quantities of protein given, while such might bind the excess acid for the time being, it also encourages a higher secretion of it because of its chemical nature and quantity of the food taken (coaptation juice of Pawlow). It is plain, therefore, that while this treatment is indicated in one way, it is contraindicated in the other. For this reason, the

use of belladonna (or atropine) taken by mouth is a measure worthy of adoption in the cases in which excessive secretion and motility exist, rather than the one of increasing the quantities of protein as these gastric functions are 'worked up.' Belladonna is a drug which combines the faculties of controlling secretions and movements of the gastro-enteron. It can be given with the Lenhartz treatment, or employed when no food is given by mouth. When begun, its administration should be steady in moderate-sized doses, and continued until its constitutional physiological effects are obtained. This is usually brought about, in the average case, by 0.5 cubic centimeter doses of the tincture, given at three- or four-hour intervals, in about two days. At the onset of the symptoms due to the drug, its employment should be continued in about one-third of the above-mentioned quantities, and maintained all of the time that the patient remains in bed. The running amounts of the drug then taken should always be short of again producing or maintaining the physiological effect produced in the first instance. In cases of acute gastric ulcer which present marked vomiting of sanguineous acid fluid or intense boring pain in the stomach after feeding, the use of belladonna is often most striking in its results. It seems as though when the gastric secretion and motility are held in check by its use, the subjective symptoms are at once ameliorated, and since apart from the comparatively slight disagreeable features of dryness of the fauces, dilatation of the pupils, etc., from it, it is the medicament *par excellence* for these cases, and about which, in this connection, the following advantages may be enumerated:—

- "1. It effectively and always positively controls excessive secretion and motility, thereby favoring repair of the ulcer.
- "2. It holds in check the increased stomach secretion which the Lenhartz treatment is liable to bring about, and thus holds back the amount of hydrochloric acid to be bound by the proteids.
- "3. It has a better effect on the relief of the symptoms of pain, vomiting, hemorrhage and local gastric distress than any other medicament—bismuth, silver nitrate, the alkalies and morphine all included.
- "4. It does not interfere with the binding or digestion of the protein content of the Lenhartz feeding, since such acid as may be secreted the protein will care for, and such excess of proteins not so met with can be cared for in the small intestine.
- "5. It is easy of administration to these patients because of the smallness of the dose, almost tasteless, easily borne, does not interfere with the digestion, and can be taken on an empty stomach.

"6. And last, the great bugbear of distention of the stomach of an atonic nature is not brought on by its use when only the smaller-sized doses are employed after the first few days."

The principal drugs used for their astringent action and in the hope of stimulating the ulcered surface to cicatrize are nitrate of silver and perchloride of iron; of these, the first is the more generally employed. Silver nitrate, which has also been recommended as an antacid, may be given in pill form 0.015 to 0.03 ( $\frac{1}{4}$  to  $\frac{1}{2}$  grain) at a dose, or in solution with a small amount of sodium bicarbonate (0.5 to 1.0). Boas used silver nitrate in solution 0.25 to 120 cubic centimeters, and gives it in gradually increasing strength up to 0.5 to 120 cubic centimeters, adding peppermint water to prevent nausea; of these different strength solutions a tablespoonful is taken on an empty stomach three times a day. To prevent the conversion of this salt into a chloride, the solution must be given through a tube, or the dry salt in the form of soft pills. Up to the present time, I have not observed any special desirable results from the use of silver nitrate. Of course, cases are met with in which it may be believed that benefits come from its use during the acute stage, but it must not be forgotten that recovery in ulcer is often most rapid, and occurs even in spite of improper treatment. However, the silver solution seems to answer to some purpose in the late treatment, and I think that when employed as a sprayed solution it serves to the best advantage.

Leube's method in full comprises the following: The patient is placed in bed for ten days, during which time the epigastrium is washed with alcohol and sublimate solution, then boric ointment is applied on a thin cloth, and over this a hot flaxseed poultice every fifteen minutes for ten hours during the day and a wet compress during the night. After the tenth day, an abdominal flannel binder is worn during the day and for three weeks a simple cold compress at night.

During the convalescence, the patient should rest completely for two hours after meals. The contraindications for poultices are menstruation and recent hemorrhage (within three months), preference being given to an icebag when recent hemorrhage occurs. One pint of Carlsbad water is drunk slowly in the morning for one month; and alkaline waters during the day. Bismuth and sodium bicarbonate may be used. The constipation is treated by enemata of tepid water or Carlsbad salts, or, after the eleventh day, by 4 grams (1 dram) of a powder consisting of powdered rhubarb, 20 parts; sodium sulphate, 15 parts; and sodium bicarbonate,  $7\frac{1}{2}$  parts. For the first ten days the diet consists of boiled milk, Leube's meat solution, and soft, unsweetened

zwieback. Then for the next week, rice or sago soups, boiled with milk or white of egg, and soft-boiled or raw eggs. Later on tender meats, and after the fifth week careful ordinary dieting. In the presence of a positive Wassermann antisiphilitic treatment is required, and oftentimes the most remarkable results take place from this alone. In my opinion about 8 per cent. of ulcers are syphilitic in origin. When infective tissue, such as is often met with in the appendix, gall-bladder, prostate, female pelvis, teeth, tonsils or head sinuses exist they should have attention.

**Treatment of Individual Symptoms.**—For the pain, if severe, a hypodermic or two of morphine may be necessary in the first day or two. In my experience this rarely is called for, belladonna internally and possibly also codeine answering for most all cases. Einhorn recommends the use of chloral hydrate as a sedative and antiseptic combined, but in my belief it is too irritating to the stomach mucosa in these cases even in only 0.13 to 0.30 gram (2 to 5 grain) doses. Orthoform or anesthesine may be employed in severe cases. Usually, however, when the rest and diet have been instituted, a wet compress over the abdomen is soothing and answers to control the pain. For the purpose a so-called "sweat bandage" may be employed, which is easily applied in the following manner: A large soft towel is soaked in cold water and wrung out so that it does not drip. This is then folded lengthwise and wrapped around the waist of the patient, over which rubber sheeting or oiled silk is placed, and then a dry towel to bind these in place; this bandage is changed two or three times in twenty-four hours. In place of this an icebag or flaxseed poultice may be used on the epigastrium.

For the vomiting, bismuth, belladonna, ice, and opium suppositories are recommended. It usually subsides in a few days of routine treatment and thus requires no special attention. When this is severe, however, I have observed much benefit arise from the use of a mustard plaster to the epigastrium, which, when the skin is well reddened, is immediately followed by an icebag. When the vomiting is persistent and the stomach intolerant to food duodenal alimentation would be in order, and milk, lactose and raw eggs may be used this way so that eight feedings can be made to represent 2850 calories a day giving 100 to 300 cubic centimeters at a feeding.

For the anemia, albuminate of iron may be given, as Ewald suggests, by adding 4 cubic centimeters (1 dram) of a 2-per-cent. solution of iron sesquichloride to 2 ounces of albumin water. One or two teaspoonfuls of liq. ferri albuminati, or liq. ferri peptonati cum mangano may be given thrice in twenty-four hours in a little water. In the late treatment the astringent forms of iron and arsenic

answer to the best purpose. The following is particularly to be recommended :—

B Arseni trioxidi .....	0.03	gr. ss
Ferri sulphatis .....	7.0	ʒij
Potassii carbonatis .....	3.5	ʒj

M. et fiat pilulae no. xxx (soft).

Sig.: Take one pill three times a day.

For hyperacidity, bismuth subcarbonate, belladonna, and the mineral alkalies and alkaline mineral waters are employed. Although it is generally advisable to use these separately, the following combinations may be employed :—

B Belladonnæ pulv. .....	2.0	ʒss
Sodii carbonatis .....	30.0	ʒj
Magnesii oxidii .....	40.0	ʒx
Talci purificati .....	15.0	ʒss

M. et fiat pulv. no. xxx.

Sig.: Take one powder in water every four hours.

Or, the following of Stockton's :—

B Cerii oxalatis .....	1 part or 10.0
Bismuthi subcarbonatis .....	2 parts or 20.0
Magnesii carbonatis .....	4 parts or 40.0

Fiat pulv. et sig.: Take half a teaspoonful every four hours.

. When a copious hemorrhage is present a hypodermic of morphine, which is the best internal hemostatic we have, may be necessary. For the less severe forms, adrenalin chloride solution 1 to 1000, 10 to 20 drops, three or four times a day may be effective. Bismuth subgallate, absolute rest and quiet, and small pieces of ice to suck may answer. Ewald uses ice-water lavage, and others recommend gelatin-water, but, as death from hemorrhage occurs in only about 3 per cent. of cases, these are rarely called for. When the pulse is very small, anemic murmurs appear, or cerebral anemia occurs, normal saline infusions are indicated. If given subcutaneously, a rather large cannula should be used and the injection made deep into the subclavicular region or under the breast in the female. In a few cases direct transfusion of blood is necessary. The saline solution should be at the temperature of the body, and at least a liter introduced at one time. When the hemorrhage is moderate and continuous and the patient shows constitutional effects from the bleeding, the saline solution (7.5 to 1000) may be introduced in a steady way by the rectal route, using the Murphy method for the purpose. Transfusion is one of the most efficient ways of controlling bleeding but it must not be done too early.

Lavage of the stomach is essential if much fermentation of the gastric contents is present. This, however, is rarely seen during the

course of acute ulcer, and is more apt to be met with late when stenosis or marked atony exists. Lately, Kaufmann has advised lavage in acute hemorrhage, claiming that by the cleansing of the stomach of foods, accumulated blood, acid secretions, and gas, a contraction of the empty organ takes place, acting as a hemostatic to the bleeding area.

The advent of a perigastritis usually requires a prolongation of the treatment in bed, and possibly the use of opium suppositories, or cocaine internally to relieve the pain. The use of the latter is often serviceable.

B. Opii pulv. (or pulveris) .....	1.5	gr. xxv
Bismuthi subnitratis .....	30.0	ʒij
Cretæ præparatæ .....	25.0	ʒvj
Sodiæ bicarbonatis .....	30.0	ʒj
M. et fiat pulv. no. xxx.		
Sig.: Take one powder every four hours.		

**Therapeutic Use of the X-rays.**—For the repair of gastric ulcer, a cicatrix must be formed which is smooth and even on the gastric side and complete in structure. There is no doubt that the commonly seen aftermath of symptoms in cases of acute ulcer coming on after or existent from the acute clinical days are as often due to an incomplete state of the repair of the glandularis and resulting unfavorable conditions persisting in the stomach as are these symptoms due simply to a persisting or resulting hyperchlorhydria, sensory disorder of an irritative type, or resulting atony. In fact, it must be the first thought of the attendant in every case, which, after leaving the bed, continues to complain of gastric symptoms, that the ulcer is not in a good state of repair, rather than assuming that the cicatrix is perfect and that now only a neurotic condition exists. A cure is a cure in all that the term means, and not an assumption based solely upon the fact that at one time the patient was in bed for weeks and now he is about again.

We are familiar with the mysteriously wrought beneficial effects of the X-rays in skin affections, particularly its stimulating properties in the repair of cutaneous ulcers of all types and its discutient effect on cicatricial conditions, such as may be seen in scars of healed furunculosis of the neck, cicatrices from injuries, keloid, etc. Now, if such can be accomplished in the skin, have we not reason to believe that ulcers or cicatrices from them in the stomach (which when empty is not much less accessible to the rays than the skin) may likewise be favorably influenced by its use? My interest in the use of the rays began with a case of acute gastric ulcer which persisted in giving gastric distress after the acute stage, and in which surgery seemed to be the logical therapy to advise. Since then I have used the rays in many

instances and I believe it has served me well in so far as relief of gastric symptoms and what I could learn from test-meal and fecal examinations and clinical physical measures are concerned.

The above statistics represent cases which were seen by me for the first time more or less late in the course of the disease, and had been diagnosed and treated by others before I saw them. Judging from their histories and my own examinations, I believe each of them to have been cases of gastric ulcer of the distinct clinical type, and that in each of them an ulcer or an incomplete repair or an irritated or stiff scar existed at the time I first saw them.

While the therapeutic use of the rays is by no means a panacea in the treatment of such conditions and is not offered as a substitute for surgery, it is, in my belief, a measure which, along with dieting, medication, etc., is worthy of adoption in post-ulcer conditions, such as irritable stomach, excessive secretion, recurrent hemorrhage, chronic ulcer; first, because its use will not interfere with any medical treatments that may be instituted in the case; second, its use seems to be logical and harmless; and last, because of the success achieved in these cases. One must be careful, however, since these patients are usually so anxious about themselves, impressionable to psychical influences, usually neurotic from long-standing pains, age, etc., that the benefits are not suggestive in nature, and that the subjective benefit derived is not put down to a better state of stomach conditions, unless such can be proven by test-meal or fecal examinations or by physical methods. Anxious as I am that the X-rays shall receive a more extensive trial in these cases than is possible by me, I would much prefer that such good results as may be reported should be *bona fide* ones in only plainly evident cases of these conditions. Only in this way and with a much greater number of such cases treated than I have had, could its true value be learned. Of late I have used and advised its use in every case of acute gastric ulcer I saw, beginning with the time that the patient left the bed. It is usual to find that during the course of treatments the excess of HCl secretion becomes lessened; whether this is directly brought about by a better state of repair in the stomach, an atrophic effect on the acid cells in the gastric tubules by the rays, or only indirectly so, I am unable to say. In eleven of my cases slight continuous gastric bleeding existed, and the hemorrhage stopped in all in about the third week of treatment. The stomach usually becomes less irritable to food, and thus postprandial pain and distress, nausea, and vomiting are controlled, and, as these subside, patients take more food, digest it better, and improve generally.

The technique of the rayings was simple, consisting of exposures of the center of the upper abdomen every other day until the skin showed changes from the rays. The exposures were then discontinued for a while, and begun again in the course of two or three weeks until at least twenty-five exposures had been made. The stomach should be empty at the time, a tube of medium hardness employed, and the treatments given in the prone position. With a skin that will stand it and in an improving case, the rayings may be kept up for a number of months, or until it is probable that no further benefit from them can be derived. It is unnecessary to include here records of cases so treated; reference to the literature will be found in footnote 11.

**Surgical Treatment.**—Depending upon the number, extent and depth of ulcers, location, the length of time and the character of treatment employed, and the willingness of patients to follow the advice given, the results of medical treatment vary. It is for these reasons that statistics of medical failures have been reported as all the way from less than 1 per cent. to as high as 22 per cent. However, even under the best of conditions, and in the best of hands, failure is met with, and particularly is this true in perforations, the sequels, and chronic ulcer. Uncomplicated ulcer is always a medical condition in its early stages, and even in instances of chronic ulcer in which induration has occurred cure is often obtained. It must always be remembered that fibrous induration is a stage of healing of an ulcer.

Surgical interference, on the other hand, shows a most gratifying diminution in mortality and greater number of successes each succeeding year. Beginning with modern figures, those of Hartman, 1895 to 1899, 23 cases with 6 deaths, 25 per cent., may be taken as the start, and those of Moynihan, 251 gastro-enterostomies, etc., for simple chronic gastric or duodenal ulcers, including hemorrhagic cases and hour-glass stomach, 3.5 per cent., and Mayo Robson's 210 gastro-enterostomies, etc., 3.8 per cent., may be taken as the latest authentic figures. It really seems not too much to expect that among the average surgeons future years will show a lower rate of mortality than to-day exists (which now runs from 5 to 10 per cent.), and for this reason it seems logical for the internist to refer to surgeons those cases which do not make favorable progress under medical treatment carefully carried out. The best surgeons now record a surgical mortality of chronic gastric and duodenal ulcer of under 2 per cent.

In regard to the clinical side of the subject, it may be stated that in copious hemorrhage cases surgery often fails. The reasons for this are that these patients are usually but poorly fitted to withstand the shock of

operation, it is often impossible to find the bleeding vessel, and gastro-enterostomy generally serves a poor purpose in checking the hemorrhage. Von Leube found uncontrollable hemorrhage to be the cause of death in only 1 per cent. of his cases, and surgery, even in the best of hands and under favorable conditions, cannot offer better results. For these reasons it is desirable to withhold operation, adopting it only in cases which have a continuation of recurrent hemorrhages after careful treatment.

Perforation, however, always requires surgical procedure, the percentage of recoveries from medical treatment being only about 5 per cent., while that of surgery when instituted early enough being over 65 per cent. The question of doing a gastro-enterostomy after the perforation has been closed (advised by many surgeons because of the multiplicity of ulcers) depends upon the site of the perforations and the condition of the patient. The nearer to the pylorus and when in the duodenum and the larger the rent, the greater is the necessity for better stomach drainage. In favorable cases, a gastro-enterostomy should be performed in each instance, for by its rest of the stomach is permitted, dilatation soon disappears or is obviated, the stomach secretions become more nearly normal, and the influx of bile and pancreatic juice into the stomach does no harm, at least not during the time that the perforation is healing. But, on the other hand, when, after the perforation is secured against further leakage and even when in doing this the pyloric region may be somewhat narrowed, if the general condition of the patient is not good no further surgery should be done. On a number of occasions I have advised against further surgery, even against stern arguments of operators who were fearful of the narrowed pylorus, and all of the cases have fully recovered without requiring subsequent operation for this narrowing.

When the diagnosis of perforation of the upper abdominal area is made, the patient should be placed with shoulders down and hips raised, and kept in that position until the abdomen is opened; this prevents the spreading of the infection to the lower abdomen. No foods or stimulants should be allowed by mouth, and peristaltic rest should be secured by application of cold to the upper abdomen and perhaps the use of opiates before operation. If the shock is severe an intravenous injection of salt solution materially improves the condition. The operation should be accomplished in as short a time as possible, as time is vital. Murphy,<sup>12</sup> whose advice on the post-operative treatment of perforation cases is particularly instructive, advises a continuous proctoclysis of warm normal salt solution when the patient is returned to bed after operation. This author states that he has given 30 pints of normal salt solution in twenty-four hours to a patient eleven years old,

and that the retention of fluid in the colon depends entirely upon its method of administration. The fluid should be administered through a fountain syringe to which is attached a  $\frac{3}{8}$ -inch rubber hose fitted with a hard-rubber or glass vaginal douche tip with multiple openings. This tube should be flexed almost at right angles 3 inches from its tip. The tube is inserted into the rectum to the angle, and is secured in place by adhesive straps binding it to the thigh or by perineal straps so that it cannot slip out. The rubber tube is passed under the bedding to the head or foot of the bed, to which the fountain is attached. The reservoir should be suspended from 6 to 14 inches above the level of the buttocks, and raised or lowered to just overbalance hydrostatically the intra-abdominal pressure—*i.e.*, it must be just high enough to require from forty to sixty minutes for  $1\frac{1}{2}$  pints to flow in, the usual quantity given every two hours. The flow must be controlled by gravity alone and never by a forceps or constriction on the tube, so that, when the patient endeavors to void flatus or strain, the fluid can rapidly flow back into the rubber tube; otherwise it will be discharged over the bed. It is this ease of flow to and from the bowel that insures against overdistention and expulsion. The tube should not be removed from the rectum for two or three days. When the nurse complains that the solution is not being retained it is certain it is not being properly given. Murphy regards, next to the conservative technique of the operative procedure, proctoclysis as second in importance as a life-saver. In my experience, the use of a heating apparatus about or in the can holding the saline solution is not necessary. An ordinary irrigating can or fountain syringe bag, with the tube to the rectum held between two hot-water bags at the side of the bed, is far more practical for keeping the fluid entering the rectum at a normal temperature.

Of the post-ulcer conditions that require surgery may first be mentioned hour-glass contraction. In these a communication can be formed between the two sacs by the performing of operations designated as gastroplasty and gastrogastrostomy. These are performed with or without gastro-enterostomy according to the requirements. When the contraction is in the pyloric region and partial, the ideal operation is partial gastrectomy, which removes the total area of disease and unites the divided healthy ends of the stomach. Gastro-enterostomy alone usually affords but little relief to these cases, for to be successful both sacs should be connected with the intestine, and this is a serious operative procedure and the dangers of the formation of a vicious circle are doubled. The mortality of these operations for this condition has been variously reported from different sources, but about 10 per cent. can be taken as the mean average of them all.

Post-ulcer cases that develop gastric atony are those secondary to pyloric stenosis, or the primary form. When the first mentioned is met with it is well first to temporize for a time with a special diet consisting of fluids and semisolid foods and the solid foods in finely comminuted form. The meals should be frequent, about three or four hours apart, and the quantity taken at each time small. But after a length of time of such treatment if relief is not afforded, the performance of the operations of partial gastrectomy and gastro-enterostomy is to be advised. The instances of incessant pains from old perigastric adhesions may be temporized with by medical measures and the use of potassium iodide or syrup of hydriodic acid. When the suffering is not relieved, and the patient shows advancing debility, anemia, emaciation, etc., surgery is indicated.

In post-ulcer persistent gastrosuccorhoea and hyperesthesia or gastralgia, operation should be withheld until a thorough course of medical treatment and the use of the X-rays have been tried. These cases, with instances of recurrent bleeding, often clear up sufficiently for comfort, and in accomplishing this a return to the rest treatment for two weeks or so is sometimes desirable. If, however, in the face of strict régime and thorough treatment, any one of these conditions runs a chronic course, operation is in order. Here partial gastrectomy is the first choice of operation, and gastro-enterostomy the second.

True chronic ulcer is generally a surgical condition. However, the use of special dieting, bismuth, belladonna, rest, the X-rays and the tonics is advisable for a while. In the failure of these, mixed treatment should also be tried for a short time, for in a few instances it may give most surprising results. As a rule, because of the adhesions and engorgement of vessels that exist, the only operation that can be performed is gastro-enterostomy. This is unfortunate, because these are particularly the types of ulcers that are liable to undergo carcinomatous degeneration and thus should be excised.

The proper course to pursue in cases of duodenal ulcer is to-day considered as surgical by all surgeons and most of the internists. This is mainly due to the bright results from surgery in these cases, and because the type of ulcer clinically met with is mostly chronic in nature. While there is no doubt that surgery is the best therapy in a general way, there is good argument against immediate surgery for all cases. Accepting Mayo's figures of 401 duodenal to 201 gastric ulcers operated upon in 621 cases, duodenal ulcer is met with twice as frequently from a surgical standpoint. Does this mean that more ulcers occur in the duodenum than in the stomach, or that there is no difference between these two organs and that more of those in the stomach heal up, or does

it mean that the duodenal ulcers are more prone to chronicity from the start? If it is the first, medical treatment for the time being is favored; if the second, they should be judged as border-line cases; and if the last, immediate surgery is favored for all. From autopsy findings, I am inclined to believe that many times more ulcers occur in the stomach than in the duodenum and that the majority of these heal, and, from a clinical standpoint, that at least one-quarter of the duodenal ulcers heal under medical means if the treatment is carried out by the patient over a length of time, which means three weeks of bed and diet treatment and about six months of careful dieting. Therefore it is that when the diagnosis of unperforated duodenal ulcer has been made, however long the history suggests that the patient had suffered from it, I adopt the medical treatment first. In the great majority of cases, about a week of this renders the patients symptom-free. After the third week, I install them on the diet employed by me to reduce excessive secretion, and continue this for about six months, making fecal examinations for blood and other observations of the patient during the time.

Before they go to bed, explain to them that surgery may be necessary at any time, and that the treatment may not be successful to obviate this. If they choose the operative risk rather than carry out the length of medical treatment, they are operated upon at once, and if they agree to the medicine this is adopted. At the end of the bed treatment (when they usually are much improved), I again draw the possibility of operation to their attention. After the elapse of six months, if all had been well and the case looks most favorable, regular foods are allowed. Now, should the symptoms not subside during the bed treatment as an ulcer case logically does, or the bleeding continue after the first week, or there be a return of the pain after the bed treatment (either during the subsequent dieting of six months or after this when they have returned to regular fare), or if there is only an amelioration of the local symptoms and the general health does not improve, I advise operation at once. The operation of choice is posterior gastro-enterostomy. As clinical work runs about 10 per cent. of these cases are not benefited by operation or develop new ulcers after it and sometimes because of it. But this is a better rate of success than by medical treatment of the intractable cases.

Gastro-enterostomy is often a curative operation in cases of gastric or duodenal ulcer when the pylorus is more or less completely occluded. If the pylorus is quite patent gastro-enterostomy is very liable to give no, or only transitory, relief unless the ulcer or the ulcer-bearing segment of the stomach is resected.

Carcinomatous degeneration is always a surgical condition, and excision of the diseased area and the surrounding adhesions with the enlarged lymph glands is necessary.

It may also be mentioned that when results from medical treatment are not or apparently would not be successful, the patient should be assured by the physician that nothing can be accomplished by internal means and the advisability of and lack of danger in performing exploratory incision should be dwelt upon. Only in these ways is it possible to get the majority of the patients to consent to operation, and to accomplish this an insistence on the part of the attendant and intelligence and length of suffering on the part of the patient are usually necessary to bring it about.

A number of cases in which gastro-enterostomy has been performed subsequently develop enterocolitis. This, I believe, is due to the change in the process of digestion brought about by the abnormal motility and secretion from the operation, together with the fact that the average surgeon permits his patients to eat almost anything after he is out of bed from the operation. In the course of time this leads to a diarrheal condition, with serious effects upon the general health, which may not be seen for a year or two afterward. For this reason it is important to maintain a diet suggested for the treatment of hyperacidity for some weeks or months, and then, when solid foods are allowed, to advise the following: Care to be taken that all foods are fresh and cleanly cooked and served, and no foods eaten that have been standing some hours in a cooked condition. The mouth should be cleansed with plain warm water, preferably with a little bicarbonate of soda dissolved in it, before and after meals and when possible at other times. Preference should be given to four meals a day, moderate in amounts, or three meals a day with small supplemental meals between them and before retiring. Thorough cooking, cutting the foods finely on the plate or mashing them, complete mastication, and slow eating should be advised. Foods should not be eaten under conditions of fatigue, mental excitement, or depression, and a rest in a reclining position for one hour after the main meals is desirable. No condiments should be allowed and the use of salt restricted. When there is distress in the stomach, a glass of warm flaxseed water before meals and a glass of cool water about an hour after meals are beneficial. The safest foods are bouillon, broths, consommés, and purées; any of the well-cooked cereals, served with milk, fresh cream, and sugar; eggs in any form and not taking more than two a day; breads, rolls, zwieback, biscuits, and crackers; all foods made of gelatin, not more than two or three ounces of meat, fish, poultry or game in a day, and these finely cut; any of the vegetables, providing they are cooked to softness and are

not of the rough variety, the safest being peas, beans, and lentils; the green vegetables and salads are allowed; other foods of value are custards, egg and milk, and peeled fruits; jellies, marmalades, green chicory, and spinach. The main points in the diet are that the meals should be soft or semisolid, eaten slowly, the foods fresh, taken in moderate quantities at a time, and resting after meals.

A few instances of gastro-enterostomy subsequently develop jejunal ulcer which was at one time supposed to be due to linen suture material but now found to be due to effects of the gastric juice. These cases usually require operation again, as those often do which have mass adhesions following the gastro-enterostomy.

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## CHAPTER XXI.

### Malignant Diseases of the Stomach.

#### GASTRIC CARCINOMATA. (Carcinoma Ventriculi.)

##### PRELIMINARY REMARKS.

THE stomach is more frequently affected with cancer than any other organ of the body, comprising about one-fourth of all cases. Haeberlin<sup>1</sup> first pointed to the fact that the frequency of gastric cancer is steadily increasing, and Bryant,<sup>2</sup> who compiled statistics of cancer cases in the United States from 1850 to 1890, showed the deaths per 100,000 living to be: 1850, 9.0; 1860, 11.7; 1870, 16.0; 1880, 26.05; 1890, 33.5. It is probable that the death rate to-day is higher, mainly because more correct diagnoses are made than formerly rather than that the disease is increasing in frequency. According to Welch, cancer of the stomach is the cause of death in 1 per cent. of all persons dying after the age of twenty years. It occurs in men more frequently than in women, the average being about twice as many cases more. It is most common in the light-skinned races, the pure-blooded negroes being practically exempt. It is said to be rarely found in Egypt and in some of the South American countries.

Cancer is a disease of late middle life; the average age at death in 600 cases which Britton collected was fifty years. The same authority gives the maximum liability between sixty and seventy. Welch's statistics of 2975 cases of stomach cancer show the following according to the ages: 10 to 20, 2; 20 to 30, 55; 30 to 40, 271; 40 to 50, 499; 50 to 60, 620; 60 to 70, 428; 70 to 80, 140. According to this the maximum liability lies between the fortieth and sixtieth year. Cases in younger life are rather rare. Mathieu, up to 1884, collected from literature 27 cases of gastric cancer below the thirtieth year. The author has observed 27 cases of stomach cancer in early life. Others have reported cases in young persons, some as early as the tenth year.

The argument is frequently advanced that the increase in cancer is only apparent on account of improved methods of diagnosis in the ascertainment of internal or ordinarily inaccessible cancers. As a matter of

fact, there has been an increase in practically all forms of cancer, as shown in the table following, which is limited to twelve American cities, since for the remainder the advance information of cancer deaths by organs and parts during 1916 could not be secured. The cities included in this comparison are Buffalo, Baltimore, Boston, Cincinnati, Cleveland, Detroit, Indianapolis, Milwaukee, Minneapolis, Newark, New Orleans, and Greater New York. The group of cities, however, may be considered fairly representative for the nation at large.

MORTALITY FROM CANCER BY ORGANS AND PARTS IN TWELVE AMERICAN CITIES, 1911-1916  
Rates per 100,000 of Population.

	1911	1912	1913	1914	1915	1911-15	1916	Difference in Rate to that of 1911-15 Actual %
Buccal cavity .....	3.4	3.4	3.6	3.6	3.5	3.5	3.5	.... 3.4
Stomach & liver ...	31.4	32.5	32.6	33.2	33.6	32.7	33.8	+1.1 3.4
Peritoneum—								
intestines .....	11.6	11.5	12.4	12.9	12.2	12.1	13.3	+1.2 9.9
Female genera- tive organs .....	12.3	13.2	13.1	12.9	13.8	13.1	13.3	+0.2 1.5
Breast .....	7.7	7.4	7.4	8.1	7.4	7.6	8.5	+0.9 11.8
Skin .....	1.3	1.6	1.4	1.5	1.9	1.5	1.7	+0.2 13.3
Others .....	13.8	13.8	14.5	14.8	15.9	14.6	15.9	+1.3 8.9
Totals .....	81.5	83.4	85.0	87.0	88.3	85.1	90.0	4.9 5.8

It has not seemed necessary for the present purpose to include in this table the original population and mortality data. The rates, however, are given by single years for the six-year period, and the seven groups of organs and parts, including the not specified, so as to facilitate the analysis of the data in sufficient detail for practical medical and insurance purposes. According to this table there was a relative increase in cancer frequency during the year 1916 in comparison with the previous five years for every group of organs or parts, including the not specified or not specifically differentiated, with the exception of cancer of the buccal cavity, for which the rate remained unchanged. The average rate for the five-year period for all organs or parts was 85.1 per 100,000 of population, against a rate of 90.0 during 1916. There was, therefore, an actual increase in the 1915 rate of 4.9 per 100,000, equivalent to 5.8 per cent. The relative increase was most pronounced for cancer of the skin, which is obviously the most easily diagnosed form. This type of cancer, however, is relatively rare, so that the mortality rate is comparatively low. Practically the most significant increase is in the group of cancers of the stomach and liver and the peritoneum and intestines, and the female

generative organs. In these three groups the most important increase occurred in cancer of the peritoneum and intestines, equivalent to 9.9 per cent. Cancers of the breast, which next to cancer of the skin are the most easily diagnosed form, increased from an average of 7.6 per 100,000 during the five years ending 1915 to 8.5 during 1916, or 0.9 per 100,000, equivalent to 11.8 per cent. It would seem utterly incredible that this form of cancer, which has been diagnosed and understood during practically the entire history of medicine, should have been so much better diagnosed during the year 1916 in comparison with the previous five years as to account for a relative increase in the mortality of 11.8 per cent. Since efforts have been made for many years to direct particular attention to the supreme importance of early operations in cancer of the female breast, it is a foregone conclusion that but for such educational efforts and the truly marvelous results of modern surgical science the increase in the mortality in this group would have been much more excessive than has actually been the case.

Cancer, because it has been such a common malady, has given rise and force to the supposition that heredity plays some rôle in its development. While it is difficult to dispute this in any definite way, there is reason to believe that because of its apparent increasing frequency, its coming on so late in life, the nature of the disease, and the commonness of stomach affections, this is more of a coincidence than a fact of any practical moment. It may be said that the questionable theory of transmitted predisposition, still somewhat believed in connection with tuberculosis, has even less tenable ground here, and that cancer is always an acquired affection. Cancer of the stomach is primary in practically all instances.

#### ETIOLOGY.

Little of settled value is really known on this point. Theories have been advanced in numbers, all of which, because of the lack of definite knowledge on the subject, still stand unrefuted. The basic fact requiring explanation is the presence in affected tissue of cells which have capabilities of growth and migration through tissue structure. Because of the fact that all tumors appear to be local affections, direct causes for the cancer have been sought. Of these, injury and irritation appear to be tenable contributing factors. We know that the effect of these influences on normal tissue are inflammation and hyperplasia, and this means extra food to cells ready to grow and the lowering of the physiological resistance of the tissue around them. Irritation, however, does seem to be a causative factor in the production of epithelioma; as examples of this may

be mentioned the rodent ulcers and epitheliomata occurring in old scars. There is little in the thought that malignant gastric disease can be caused by trauma from without. It is possible that a sharply delivered blow, striking directly over the gastric region and affecting the stomach mucosa in the way of producing subsequent localized congestion, inflammation, or an ulcerated condition, could, after a time, cause the development of malignant disease in a susceptible individual. But, obviously, these must be but rare instances. The trauma and irritation theory advanced may have more fact in those small traumas which take place within the stomach from substances which are improper in nature for food, such as indigestible and hard substances, and in the congestions due to long-standing irritative conditions of a digestive nature, such as those in excessive or other abnormal gastric secretions. The predilection of cancer for the orifices and the commonness of ulcers and the irritative and imperfect scars resulting from the latter, when considered as forerunners of malignant disease, are rather in favor of this being so. Brinton has suggested the following explanation for cancer at the cardia and pylorus: the muscular fibers of these two stomach orifices are subjected to more contraction than the rest of the organ. this causing a richer nutrition of these parts, which may give rise to proliferation of the glandular tissue at these sites, with the formation of a malignant neoplasm. Hauser has demonstrated histologically, and subsequent clinical observations have proved the fact to be true, that ulcerated conditions often undergo carcinomatous degeneration. He also asserts that cancer may develop from an affection of the gastric glands. It might finally be mentioned that constantly applied slight traumas and long-standing irritative states seem to be causative factors in the development of malignant disease of the uterus, breast, and throat.

Malignant growths—carcinoma and sarcoma—in the obscurity of their origin, their tendency to spread locally, and their dissemination by lymph and blood paths, so closely resemble certain infectious diseases of a parasitic nature that these growths are suspected to have a like etiology. Many pathologists believe this to be so, and much of the research work on malignant disease to-day is based on the view that inoculation of some parasite which excites cell-proliferation is the true cause of these neoplasms. It is further suggested in favor of this theory that the absorption of the products of bacterial decomposition explains the cachexia and might account for the fever which is found present late in these tumors. Finally, in support of parasitic inoculation, a few cases have been reported in which cancer of one side has caused the development of cancer in the opposing surface. The fact that cancer and sarcoma can spread by the lymph and blood-currents might be ex-

plained by the easy migration of the small new cell itself and the propensity of the cell for rapid proliferation at any new site independent of the original tissue it came from, and without there being present parasitic bodies to account for it. Of the questions in this connection, the cell itself might be the invading parasite, although it has the appearance of an embryonic element, or that undeveloped laboratory technique has failed to disclose the accompanying organism. It is also possible that the cachexia is due to absorption of toxins consequent to markedly disturbed digestion and nutrition, and that the fever is from a like cause through an ulceration or a local inflammatory process of a low degree in the malignant growth. MacCarthy believes that the gastric cancer cell arises from intraglandular hyperplastic cells of the mucosa, and represents a malignant end-stage of a process of hyperplasia of normal cells.

Reviewing the whole question of etiology, it is plain that we have only more or less probable surmises. In regard to the simple tumors, Cohnheim's theory of embryonic remains or MacCarthy's seem likely. As to the process locally, the most plausible surmise to-day is, that the physiological resistance of the connective tissue is reduced or impaired until the epithelium, having ordinarily only a normal tendency to grow, can invade it, causing irritation with lowered resistance, and that then unusually rapid cell multiplication results from the consequent increased nutritive supply.

MacCarthy<sup>2a</sup> believes that chronic gastric ulcers figure prominently in the etiology of carcinoma. Clinically this has not been proven beyond possibly 5 per cent. of the instances. The conclusions of this pathologist are: There is no macroscopic differentiating structural difference between a simple chronic gastric ulcer and an early carcinomatous chronic gastric ulcer. There is no differentiating variation in muscular structure which might be the basis of diagnostic difference in gastric rhythm in simple chronic gastric ulcer and an early carcinomatous chronic gastric ulcer. The diagnosis of early carcinoma in the border of a chronic gastric ulcer is a question of the position of a few undifferentiated epithelial cells in the mucosa or submucosa, and it still remains an open question whether or not the X-rays can differentiate such small quantities of such cells from normally differentiated epithelial cells or the cells of the other tissues in a chronic ulcer.

#### PATHOLOGY.

The four main types of cancer met with are: the adenocarcinoma, the medullary, the scirrhous, and the colloid.

The adenocarcinoma, cylindrical cell or epithelioma, forms soft, fungating tumors, presenting well-marked nodules and sloughing. These often display a papillary appearance of a red color which is due to each fungosity having a small loop of blood-vessels. This latter reason accounts for the commonly observed hemorrhage on the surface and in the substance of the growth, and the blood or so-called carcinoma juice usually found within the cavity of the stomach. The specific type of cell is columnar in shape, and they are found lining numbers of newly formed tubules and mostly in the superficial portions of the pseudo-tubules. Lower down the cells are more irregular in shape, although large spaces may be seen lined with well-formed cylindrical cells. The connective tissue generally displays marked leucocyte infiltration. Small cysts containing granular matter and liquid are rather commonly seen. Adenocarcinoma may occur as a pedunculated growth, which may occlude the pylorus and closely resemble a case of benign papillomata.

The cylindrical cell carcinoma is most commonly found in the pyloric region close to the orifice. Probably because of this reason the cancer mass may grow to considerable size before the development of secondary carcinomata, although at autopsy these are extensively found in the glands, liver, lungs, etc. Ulceration of the free surface of this type of growth is commonly seen, the necrosis often extending deep into the mass or through the entire stomach wall. These growths often show a marked tendency to undergo mucoid degeneration.

The medullary or soft glandular carcinoma likewise presents fungating masses projecting above the mucous membrane. It is soft and spongy in nature, having little connective tissue, is rich in blood-vessels and cells, and on cut surface it is usually of a grayish-yellow color. This type of cancer bleeds readily, and at autopsy is generally found extensively ulcerated, presenting a scooped-out appearance with a projecting surrounding wall. The bowl-shaped central depression may extend down to the inner muscular coat. The soft, glandular cancer usually rapidly invades the outer gastric layers, forming small nodules on the external surface, enlargements of the lymph-glands, as well as surrounding involvement in adjacent structures. This neoplasm seems to have a predilection for dissemination through the lymphatic system, usually being found in all of the surrounding lymphatics and in the left supraclaviculars. Numerous cancerous nodules may be seen scattered in the abdominal and chest cavities. The primary growth may be found in any part of the stomach, although it is most common in the pyloric region.

The scirrrous or hard glandular carcinoma is distinguished from the other types mainly by its hardness, which is due to abundance of connective tissue and relatively few cells. The growth has a compact, massy hardness, cutting with considerable resistance and with a gritty sound. Portions of the tumor are of a cartilaginous nature, and of a whitish-yellow color in which are seen striations of dense cicatricial tissue. This growth shows little inclination to ulceration in its early state, but in late cases superficial ulcers may be found

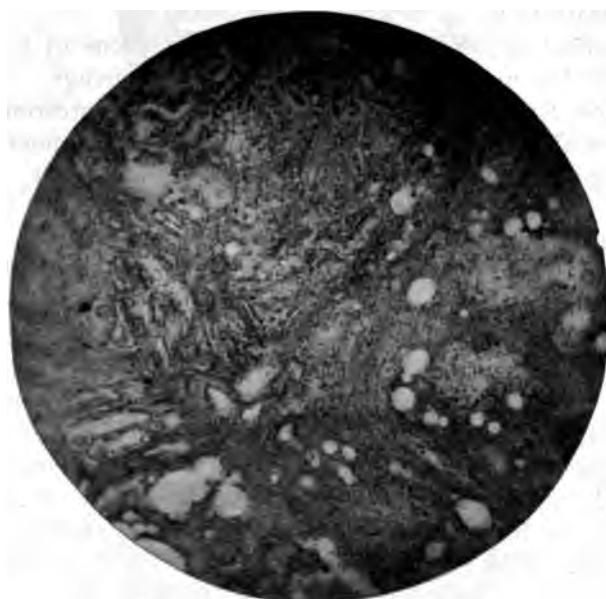


Fig. 118.—Photomicrograph of a section from a colloid carcinoma of the stomach. Note the groups of carcinoma cells and the areas of colloid degeneration.  $\times 70$ .

on the mucous surface. When these are found, they are shallow and flat. Typical cancer proliferation is often difficult to find in the primary growth, and may only be seen in the secondary cancer formations. For this reason when the cancer is small and confined to the stomach walls, it may present the macroscopic appearance of an old chronic ulcer. Extensive adhesions of the pylorus to surrounding organs (liver, intestine, omentum) are almost always present. Cancer formation is usually found in the lymphatic glands, and may even extend into the spinal column directly or indirectly from the primary growth. Because of its involving adjacent tissues, large masses may be found outside of the stomach, while the gastric growth may be

small and overlooked. The secondary growths, as a rule, are richer in cells and may present quite a medullary appearance. Because of its dense stroma, contractions are common, and, as these tumors almost always are present at the pylorus, they give rise to marked pyloric stenosis. When much of the stomach wall is involved, the entire stomach may be stiffened and contracted. In these instances the gastric mucosa may be destroyed, either by thinning, actual loss of tissue, or by chronic inflammation, thus giving the picture of a gastric cirrhosis or extreme hyperplastic gastritis; the latter two are often seen as conditions secondary to the presence of the neoplasm.

The colloid or gelatiniform cancer is simply one of the preceding forms which has undergone a mucoid or colloid change. Colloid cancers are most frequently met with in the stomach, intestines and elsewhere in the abdomen. The tendency of abdominal tumors to undergo colloid degeneration is as yet unexplained. In character, this growth is typical. The very fine stroma with the mass of mucocolloid material in its meshes gives it a light-grayish color and a soft, slimy feel, and the tumor is usually rather indefinite and irregular in shape. The growth seems to have the faculty of marked progression, since carcinosis often extends into the peritoneum and the omentum may be found broadly involved. Affections of the lymphatic glands, liver, lungs and other organs are common, and colloid material may be found infiltrating throughout the gastric walls, intestines and lymph-vessels—this latter medium may account for its so general involvement of adjacent structures. The cancer is usually observed at the pylorus, from which it may extend directly into the duodenum and adjacent liver. The esophagus may also be involved. If the degeneration ensues on a scirrhus, the involved tissue may be found contracted and hardened in places and soft from colloid accumulation in others.

Any variety of the above-mentioned types may be found present in the same specimen, and it may be difficult to say to just which type the tumor primarily belonged. The scirrhouus type is the most common. Brinton in 180 cases of cancer found the different distinguishable types—130 scirrhouus, 32 medullary, 14 melanotic and 1 epithelioma. The melanotic form is generally the medullary blackened by blood-pigment from frequent hemorrhages.

In a topographical sense, two classes of growths may be designated: those involving large areas of mucous membrane, which, in proportion, are rather definitely confined to the stomach (medullary), and those which involve relatively a small part of the mucosa, extending thickly through the walls and into the surrounding organs (the scirrhouus and

PLATE LXX.



Adenocarcinoma in the posterior wall of the stomach near the pylorus but not actually involving the lumen of the latter. This fact permitted good exit of the food from the stomach, and that accounted for the small degree of stomach dilatation. The growth is seen in the upper part of the picture and to the left. In the center of the flat fungating tumor is seen a small ulcer due to sloughing of the degenerated and hemorrhagic area at that point. This growth followed more outward into the glandulature than into the depths of the organ and did not involve the peritoneal coat. Because of its relatively small mass and softness no tumor was palpable from without.

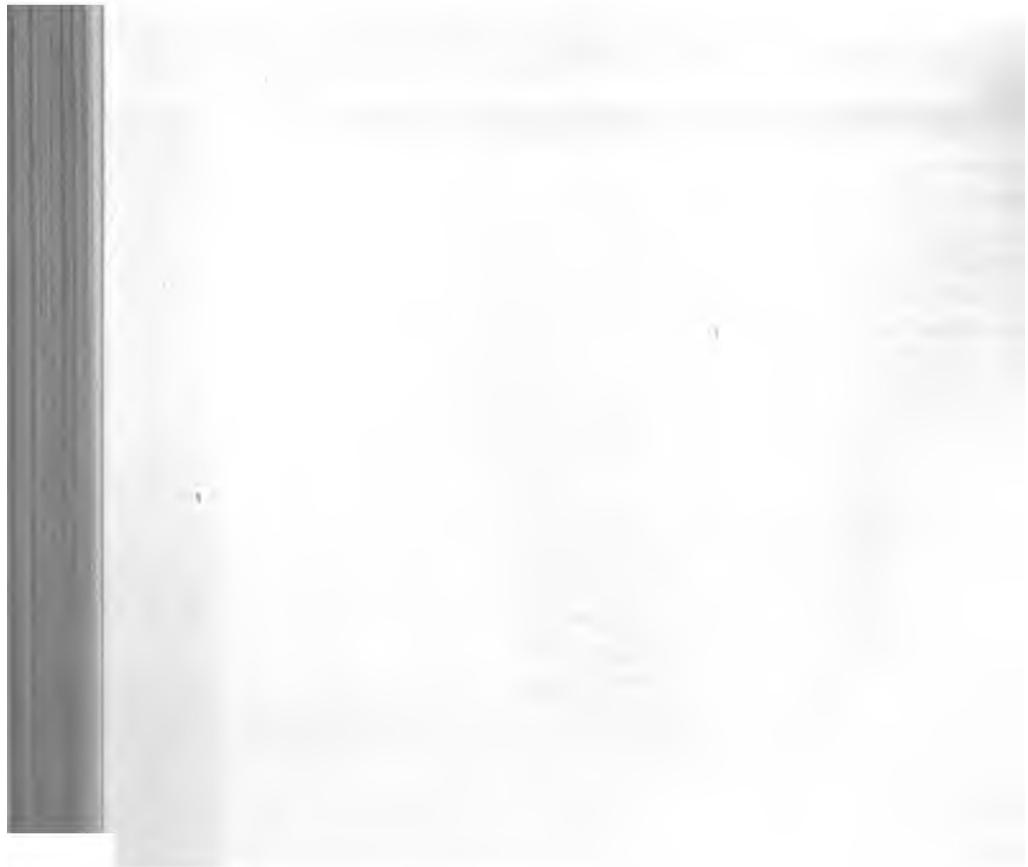


PLATE LXXI.



General scirrhus carcinoma of the stomach. The rest of the tissues, other than the stomach, have been cut away so as to show the characteristic growth within the walls and cavity of the organ. Tracing from the pylorus will be noticed a large sized carcinoma nodule beyond the pylorus extending into the lumen of the duodenum; then the pylorus itself with its general involvement, its thickening of the mucosa and musculature; coming downward into the cavity will be seen a running formation of malignant growth, in characteristic nodules, which extends throughout all of the glandulature even to the fundus, smaller nodules can be seen in the depths of the organ; at the point of the dip of the lesser curvature will be seen the marked hypertrophy of the musculature, probably due to the effort that such a stomach must have made to expel its contents through the obstructing way beyond it. The entire organ was stiffened by the callous growth. The peritoneum at the greater and lesser curvatures is seen to be much thickened.

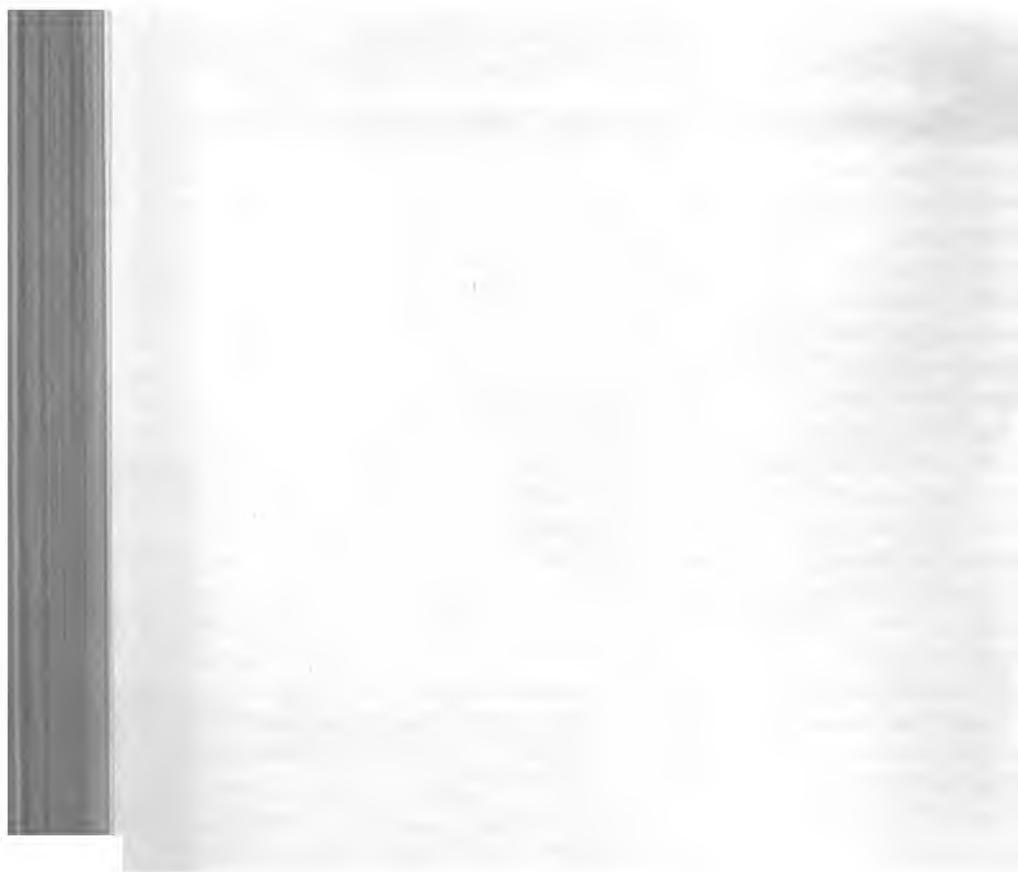


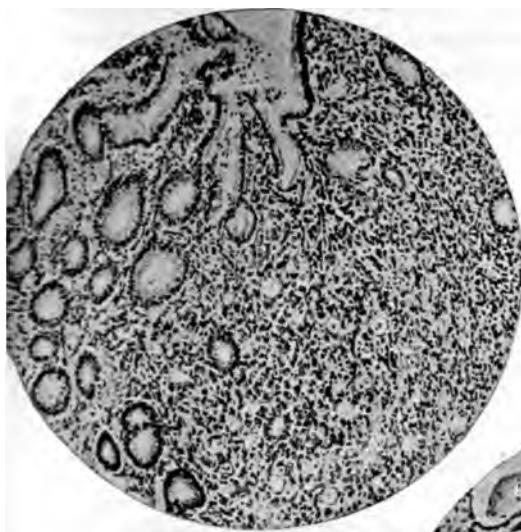
PLATE LXXII.



olloid carcinoma of the stomach. The growth is at the pylorus, and presents the characteristic diffuse thickening in the stomach walls of this type of cancer. It will be seen to have involved all of the structure of the stomach at that location and beyond it into the surrounding tissues. In appearance the growth was gelatinous and colorless, and cut through the stomach walls with a consistency like a scirrhus. Beyond this the growth was of a soft, slimy consistency. A carcinoma nodule is seen in the stomach proper left of the center. The pylorus is horizontally opposite to this point.



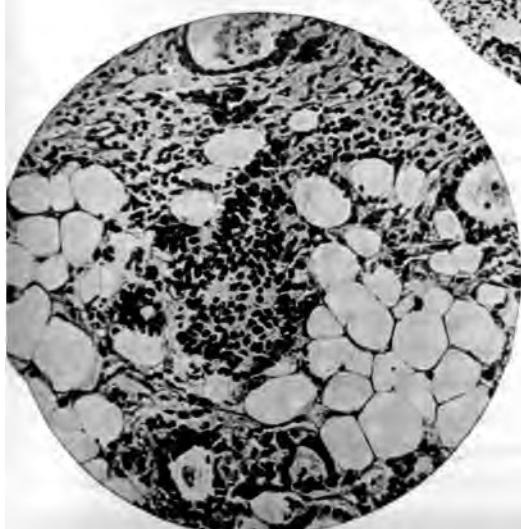
PLATE LXXIII.



Gastric carcinoma, neoplasm cells involving a course down through the glandularis.  
X112.



Gastric carcinoma, neoplasm cells involving the bases of the tubules and submucosa.  
X112.



Gastric carcinoma, neoplasm cells involving the submucosa. X195.

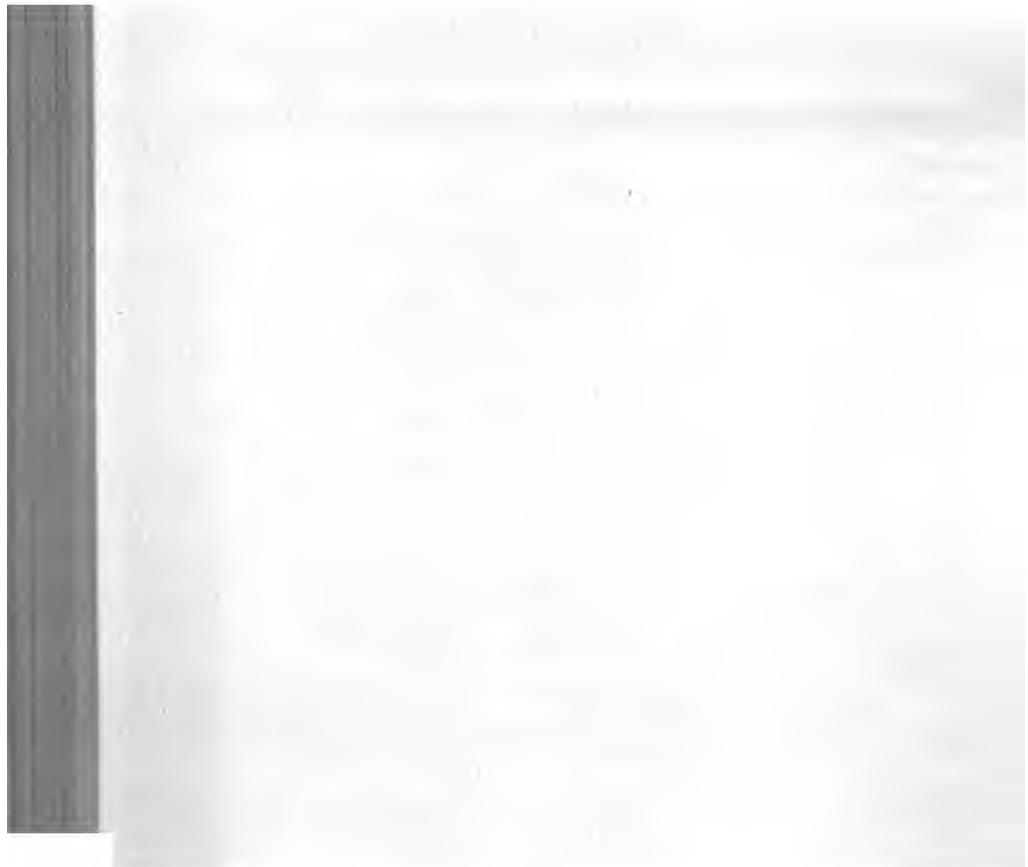
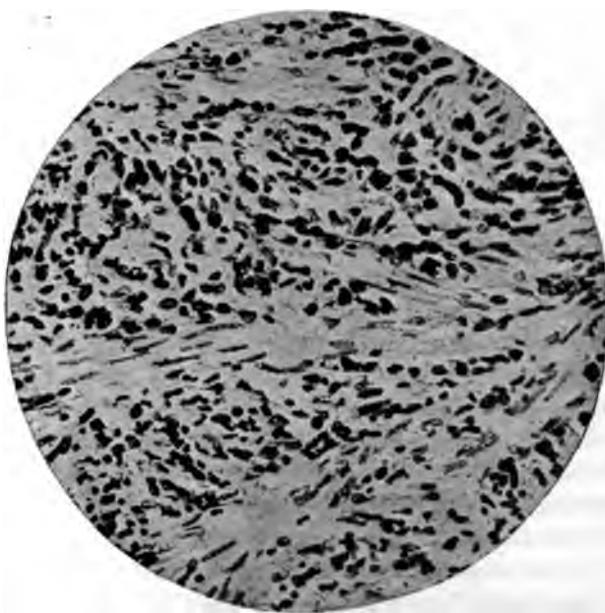


PLATE LXXIV.



Gastric carcinoma, with large collections of neoplastic cells  
in the glandularis.  $\times 208$ .



Gastric carcinoma with neoplastic infiltration of the muscularis  
with hypertrophy of same.  $\times 240$ .



PLATE LXXV.



Gastric carcinoma, with neoplastic infiltration of the glandularis  
tubules.  $\times 280$ .



Gastric carcinoma, with neoplastic infiltration of the glandularis with  
large collection of new-growth cells.  $\times 215$ .



colloid). The distinction is not uniform clinically, because of the combinations of types and differences encountered, but has a slight practical bearing on some points in the diagnosis. Carcinomatous degeneration of chronic ulcers is described under *ulcus carcinomatosum*.

Secondary cancerous growths take place by direct extension, by continuity of tissue, by way of adhesions, or by metastasis. The latter are found most commonly in the lymphatic glands, routes of lymph-vessels, in the liver, peritoneum, omentum, intestines, gall-bladder and even in the pleura and lungs. The left cervical and inguinal lymphatic glands are often affected, and subcutaneous nodules may be observed near the navel. The liver is involved in about one-third of all cases. According to Brinton, metastasis was observed in about one-half of the cases. They are more common in the medullary and colloid cancers than in the scirrhouss form. The swollen glands seen in these cases are generally due to cancerous deposits, but may be due to simple adenitis from toxic irritation. Metastases in cancer occur by way of the lymph- and blood-currents—mostly by the lymph-vessels and those in sarcoma practically by the blood-vessels only. Numerous pulmonary metastases may be found in the pleura and peritoneum, closely imitating the finely scattered tubercles of tuberculosis, and also in the central and peripheral nervous system.

#### SYMPTOMS.

In analyzing the symptoms of gastric cancer, for the sake of completeness, it is desirable to describe them in a running order—the constitutional and gastric combined. Added to these are those due to the secondary growths.

The history of onset is acute in three-quarters and of slow onset in but one-quarter of the cases.

Of first importance are the significant points in the history of these cases before they have presented themselves for diagnosis. This deals with a general consideration of the patient and particularly his past history, the age, and the subjective and objective symptoms. Of great value in this connection is the discernment and understanding of the details of the patient's report, the knowledge of and the ability to correlate significant symptoms so that the important points are grasped and massed and the non-significant ignored, and the deductive ability on the part of the history taker to separate all gastric cases from malignancy other than value cases in the early visits too lightly only to find out later at the more serious disease had existed. It is well to suspect malignancy in all middle-aged and older persons who give a history of continuous gastric disorder running over a length of time and in whom

the intervals of relief have been absent or only very transitory. With the probability of the presence of a cancer first in mind, no interference is subsequently caused in the making of diagnoses of the benign conditions, but little time is lost, and more cases of gastric cancer would be diagnosed earlier. Details of this will be taken up in connection with the diagnosis of early gastric carcinoma, are also found later in this chapter, and in chapter on X-ray Examination.

Among the subjective symptoms of first order is the sudden beginning of the affection in a person who has always been quite free from digestive disturbance or distress, or one who has had only very minor or very transitory disorder in the past. Added to this is an accompanying progressive failing in general nutrition and physical strength. Von Leube correctly states that there is full cause to think of gastric cancer when the gastric affection occurs in a person who for fifty or sixty years had a stomach which did not require care and could endure all kinds of foods. The reverse of this, in the way of constantly present dyspeptic disturbance, is observed in about one-fourth of all cancer cases, and about two-thirds give what may be termed a very transitory dyspeptic history.

#### SEPARATE SYMPTOMS AND DIAGNOSIS.

**Anorexia.**—Appetite is frequently diminished early, and thirst is increased. Anorexia, according to Brinton, was observed in 85 per cent. of the cases. In this, the aversion for meats is characteristic but not always present, for often when this aversion is apparently present there exists also the inaptitude for all foods of a very solid nature. The anorexia may be due to the fear of distress after eating, or it may be independent in its nature. I observed one case of cancer of the lesser curvature and another of the lower part of the pylorus and body of the stomach in which the desire for foods had been increased above normal. In both of these, "longings" for highly spiced and irregular articles of diet existed. However, anorexia is the rule, often profound and accumulating, for all foods excepting those of a fluid nature. An excessive thirst is common when pyloric stenosis exists.

Repugnance to meat in cancer of the stomach occurs early in the history of the case and is of diagnostic value. The repugnance is specific and does not, at least early in the disease, extend to other articles of food. In eliciting the information one should never ask a leading question about the appetite for meat, but the patient should be given every opportunity to answer the question in his own way. He may, for example, be asked what kinds of food he mostly craves or enjoys, and a number of ordinary

articles of diet should be enumerated for him to select from. If a meal consisting of beefsteak and potatoes, an egg, a glass of milk, and preserved fruit is suggested, he will be pretty sure to say that he dislikes meat. But great tact is necessary to bring out the fact of specific disgust, for the patient may have a general repugnance to all food or he may be a vegetarian from choice. True repugnance can be predicated only when the subject, having taken a morsel of meat into his mouth, spits it out either at once or when, having masticated it, he is unable to swallow it. This reaction must be permanent and not transitory. Needless to say the meat must have been properly prepared and be acceptable to the average man. The cancer subject having acquired this repugnance to meat never regains his tolerance. While there may be repugnance to any kind of meat it is often limited to red meats, while tolerating fish and chicken. The dislike referred to does not in any way depend on dysphagia or the fear of swallowing a bolus of meat.

It being granted that this peculiar disgust for meat is present, how may the feeling be explained? In cancer of the esophagus the author has seen a good appetite and even a liking for meats. As a rule in serious affections of the alimentary canal with disturbance of appetite there is no repugnance to meat unless there is refusal of all food, as in insanity and hysterical anorexia. Hence the value of the symptom in differential diagnosis. Nevertheless there is difficulty at first in differentiating cancer from nephritis and uremia in subjects who enter the office with pallor and complain of dietetic disorders. In any condition in which dry mouth and throat are due to lack of saliva a repugnance to meat may be due to inability to masticate and insalivate the food, and this condition the author has found common in the uremic and pre-uremic. The latter conditions may be excluded by the necessary blood and urinary tests. Generally speaking the cancer patient may show this repugnance while still in apparent health, before he has begun to show emaciation and pallor and gastric symptoms associated with involvement of the pylorus. There is a minority that never presents this symptom, just as there is a minority that retains all the enjoyment of food and eats to excess if allowed. Apparently the cause is not in the stomach itself, for the symptom has been seen in all forms of cancer, in ulcerated and non-ulcerated alike, and in all locations. The symptom which naturally suggests itself is achylia gastrica but according to the author this is not the cause, for he has found the disgust in cases in which the gastric juice was normally present and even in excess. The absorption of some product of the cancer hardly explains the condition, and we have only the hypothesis left of a specific biological reaction, perhaps a defense reaction.

**Eruption.**—This is a late symptom, and is due to gas-formation from gastric stagnation and fermentation. In the scirrhouous cases the gases are usually odorless until very late; in the medullary and colloid they are inclined to have an exceedingly bad smell and taste from very early in the case. These may be caused by decomposition of the neoplasm, and, of course, when stagnation exists, from the excess of organic acids and putrefaction present in the organ.

**Pain, Pressure and Distress.**—In the beginning of the affection pressure and other indescribable distress after eating may exist. In the course of time actual pain ensues in addition to this, pains which not only follow the taking of meals but which are more or less constant. Strangely enough, all of these symptoms may be altogether absent; although it should be stated that some degree of pain is a rather constant symptom. I recently observed a case of marked carcinoma involvement in a physician whose first knowledge that his failing health was due to a gastric disorder came when he felt a large and very easily palpable mass in his epigastrium. There had been no pain or discomfort after eating, just slight eructation, although the chemical and bacteriological examination of his stomach contents showed a well-advanced involvement. The pains may be in the gastric region, right hypochondrium, sternal, low in the abdomen, or in the back. In cardia affections it is often in the shoulder and thorax. It is described commonly as of a lancinating character, but may be burning, gnawing, drawing, or dull. It usually begins early, and rapidly intensifies to the exclusion of all other subjective symptoms. Whether the stomach is normally empty, after vomiting, or full of food, it is uniformly present, differing in that way from that due to gastric ulcer. When ulceration or perigastric inflammation exists, it is more severe. Late in a case, the subjective appreciation of it may be markedly dulled, or require only very simple measures to control it. In a number of cases the pain is intensified during the night.

**Vomiting.**—Vomiting is a frequent but by no means a constant symptom. It is rarely present in the early cases. In these, nausea and slight regurgitation of bad-tasting, sour fluids may be complained of, although even these may be absent until very late or not present at all. In the involvement of the pylorus it is quite constantly present, and then is due more to the stenosis causing obstruction to the exit of foods and excessive accumulation and fermentation than to the mere presence of the malignant growth itself. The vomiting at these times is of the collective type, containing undigested foods which had been swallowed one or two days before, with a large quantity of offensive fluid in which are found numerous micro-organisms,

yeast-cells, the organic acids, mucus, and sometimes changed blood and tumor fragments. Vomiting is found most frequently when the orifices are involved. Even here it may be late, while vomiting due to gastric ulcer is an early and reliable symptom. Vomiting is less frequently present when only the posterior wall, the curvatures, or the body of the stomach is affected. It may be present, however, and if so it is generally independent of the taking of foods, or occurs right after the ingestion of them. In late cases, from admixture with

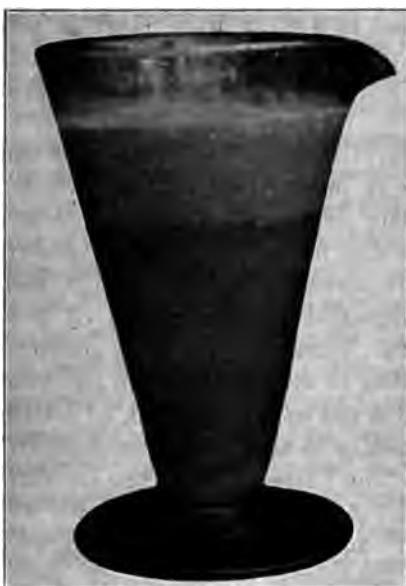


Fig. 119—Graduate glass containing stomach contents aspirated from an advanced case of carcinoma of the body of the stomach, showing its characteristic layers. The lower layer looks relatively small in amount because it had packed down from standing for twelve hours. In this case, at the end of a day in which but little food had been taken by the patient and four hours after a meal consisting of about 200 grains of buttered bread and a cup of tea, the aspirated quantity measured over 800 cubic centimeters of a coffee and milk colored, strongly butyric acid smelling fluid. There was no HCl or enzyme present, nearly 2 per cent. of lactic acid, and an abundance of Boas-Oppler bacilli.

blood from oozing or an ulcerating surface, the vomitus has the well-known coffee-ground appearance. In these cases the vomitus is blackish, a dark red-brown, or even of a greenish tinge, in which case it is very thin. Vomiting is a symptom found in the course of about four-fifths of all cases. If the growth should be pedunculated it may act as a ball valve, occluding the pylorus; giving rise to collective vomiting at times with large residues of former meals.

A characteristic feature of the stomach contents of stagnation due to pyloric stenosis is the fact that when left standing it separates into three distinct layers. The upper zone consists mostly of mucus, air and floating detritus; the middle of rather a less opaque, darker, coffee-and-milk-colored fluid; and the lower lighter in color, like the top, and consisting of settled food detritus.

**Hemorrhage.**—Vomiting of blood is observed in about one-quarter of the cases, and is due to transudation from a soft growth or bleeding from an eroding ulcer on the surface of the malignant mass. The blood may be ejected in a clear state, large or small in quantity. It is usually mixed with the contents of the stomach and much altered in color, or it may have been so changed as to present no color at all (occult blood).

When it is once established, the bleeding is usually quite constant, while that of ulcer is intermittent and can usually be controlled and stopped by appropriate treatment. Melena is not so constant a symptom as in ulcer; this is due to there being less hemorrhage as a rule, the common existence of obstruction of the pylorus, and the marked alteration and perhaps digestion and absorption of the blood before it is excreted in the feces. Vomiting of a large amount of blood may cause the quickly fatal ending of a case. Blood in test-meals or stools (occult) is observed in about 4 out of 5 cases, and, of course, the chemical tests for this would be positive in about the same number.

**Constipation.**—The bowel movements are variable, although constipation is the rule. According to Ewald, only 4 or 5 per cent. of the cases have regular movements. On the other hand, Fr. Müller observed diarrhea conditions present in 35 per cent. of all cases. This to me is a larger number than I have observed excepting in those nearing death. The constipation may alternate with a diarrhea caused by the catarrhal state of the intestinal mucosa due to decomposed foods from the stomach, or from the irritation incident to the presence of long-retained hard scybala in the lower colon and rectum, or from secondary colonic ulceration. It frequently means the beginning of the end of a case (colliquative diarrhea), and may be the proximate cause of death.

**Fever.**—In addition to the cases in which fever is due to an intercurrent affection, accompanying a resulting phlebitis, peritonitis, or pulmonary complications, there are cases of gastric cancer accompanied by prolonged fever. The cause of this is difficult to understand, although it is probably due to continuous absorption from an ulcerated surface, to an effect on the heat centers by the carcinoma toxins, or to actual inflammation about the neoplasm. It usually is

observed late, and death may occur shortly after its onset. When observed, it is generally continuous, although it may be of the intermittent form like a malaria. Several years ago I saw a case in which the presence of fever was the first symptom of a case of cancer of the stomach. The fever causes an aggravation of the condition, and further weakens the patient through systemic intoxication and debility. These latter are also responsible for the comatose state sometimes seen just before the end.

**Condition of the Blood.**—A decrease in the number of red blood-cells and hemoglobin is common. The cells may finally fall to 1,500,000 and the hemoglobin to 50 per cent. The reduction in the number of red cells rarely falls to as low as that of pernicious anemia, a point of some diagnostic value. The leucocytes may be increased to 15,000, rarely more. Schneyer<sup>3</sup> stated that the usual increase in the number of leucocytes found during digestion is absent in all cancer cases. This, in my opinion, is observed almost always as a late condition, and is due to the loss of the normal digestive functions of the stomach. It is therefore of little diagnostic significance in early cases, since on several occasions I have found it to be absent all the way through the course of cases. Occasionally, when either an ulceration or reactive inflammation is marked, a higher than normal polymorphonuclear count is noted. Anemia is present in 80 per cent. of the cases.

**Condition of the Urine.**—On account of deficient ingestion, vomiting, and long retention of food in the stomach, the urine is diminished in quantity and concentrated. The amount of chlorides may be diminished, and the excretion of nitrogen increased beyond the food values. A peptonuria may be observed from absorption into the general circulation by way of adhesions to organs not directly connected with the portal system of veins, or it may be by way of an ulcerated surface, though this to me seems doubtful. High indicanuric urines are common, particularly when peritoneal carcinosis or stenosis is present.

**Edema.**—An initial malleolar edema may be seen for a short time in an early case. Usually, however, it is found only in the late cases, when it is more of an anasarca with or without the presence of ascites. The pleura and pericardium may also contain fluid which is not caused by metastasis in them. The dropsy development is due to the reduced condition of the body, the anemia, and the intoxication. General itching of the skin, like that found in diabetes, may be present. Ascites or edema occurs in about 20 per cent. of the cases. The ascites may be chylous.

**Cachexia.**—Cancer always leads to cachexia, which is most pronounced when the emaciation is well advanced. This begins as a

faint lemon-yellowish tint, which darkens into a beeswax color later in the case. In the beginning, care must be taken not to confound the color with a slight hepatogenous jaundice. When the waxy, tanned color is present, this is not so liable to occur. To me, in a well-advanced case, the color of cancer cachexia is quite characteristic of the disease, although it must be said to very closely simulate that found in other severe debilitating illnesses—such as Addison's disease, hepatic cirrhosis, cardiac affections and amyloid degeneration. Doubts about its presence may be so confusing as to make it of questionable value, and thus it might be considered of only relative importance as a single symptom of carcinoma. It is brought about by the anemia, the subnutrition, and the cancer toxemia.

**Metastases.**—These occur commonly in adjacent and in remote organs—general peritoneum, pleura, pericardium, left supraclavicular and inguinal lymph-nodes, skin, nervous system, etc. The liver is the most frequently involved. According to Friedenwald they occurred as follows:—

255	(37.9 per cent.)	occurred in the glands.
222	(33.0 per cent.)	occurred in the liver.
54	(8.0 per cent.)	occurred in the peritoneum.
45	(6.6 per cent.)	occurred in the pancreas.
41	(6.1 per cent.)	occurred in the intestines.
14	(2.0 per cent.)	occurred in the lung.
12	(1.7 per cent.)	occurred in the spine.
2	(0.3 per cent.)	occurred in the skin.
27	(4.0 per cent.)	undetermined.

**Tumor.**—The presence of a tumor in the gastric region added to the important other symptoms is usually confirmatory of cancer. It is the one reliable symptom of the group. Owing to the position, stomach tumors of the cardia, lesser curvature, and posterior wall are rarely felt unless they are of considerable size. Those in the pylorus, anterior wall, and most of the greater curvature are readily felt when of some size. Inspection alone in an emaciated subject may disclose its presence, when it will be seen as a flattened mass raising the epigastrium (with the patient in the recumbent position). With the tips of the fingers, a hard, nodulated body of varied size and shape is generally felt, although the mass may be felt somewhat soft, perhaps small, and occasionally smooth on the surface. The mass is usually not influenced by ordinary respiration unless adhesions with the liver exist, when it would move up and down. On deep inspiration a pyloric growth or those of the curvature without adhesions may descend slightly and can be held in the lowered position during expiration. The growth is usually high, near the median line, and approaching to the right or left costal margin. From its weight it may have dragged the pylorus downward until this

is situated at the umbilicus, or even lower in the abdomen. It is accessible to palpation late in 80 per cent. of the cases seen, and is usually observed after the third month of the disease. Examination by palpation is usually made with the patient lying down, drawing the knees up and separating them somewhat to relax the abdominal muscles still further. Diverting the patient's attention by conversation is also helpful in obtaining a relaxed abdomen. Of service sometimes in the doubtful cases is examination in a warm bath or under narcosis. Inflation of the stomach may be resorted to, to bring the tumor into reach or cause it to disappear when it is posterior or in the lesser curvature and the organ is low. In a very few cases gastrodiaphany may show the shadow of a tumor when it is in the anterior wall or very general about the pyloric region. The X-ray, however, is the best method of noting the location, extent, and the type of growth.

Important points in the X-ray method of examination in which tumor formation is the main factor in their production are the following: bismuth residue after six hours, peristaltic wave jumps in the lesser curvature, marked defects in the stomach shadow at the lesser curvature or pars medica or pylorica, shortening and retraction upward of the stomach, and the manifestation of the presence of bismuth directly outside of the line of the lesser or greater curvatures.

#### DEFINITE SYMPTOMS PRODUCED BY THE LOCATION OF THE TUMOR.

##### Cardia, Pylorus and Body of the Stomach.

**Cardia.**—From the obstruction of the malignant growth (stenosing the orifice and interfering with the normal resiliency of the opening), dysphagia is common and is a cardinal symptom. The first notice of this is usually in a delay and in the labor necessary in swallowing solid foods. This is accompanied with a fullness and distress in the lower sternal region which continues until the food has passed through the cardia. The patient eats slowly, unconsciously chews his foods finer, and stops eating at intervals during the meal. He then begins to employ fluids to wash the food from the gullet, and eschews the solid forms of food (meats, hard vegetables, etc.). This stenosis grows more pronounced until finally he employs only the fluid foods. This is followed by the pitiful stage of not being able to swallow anything. When this point is reached, the food collects in the esophagus, when, after straining and retching, the patient regurgitates it. With the ejected food is generally found mucus and perhaps blood. At other times than when eating a burning pain exists in the inner

on or back, and more or less clear fluid may be ejected sputum, especially at night when recumbent. The stomach at the time of stenosis is usually considerably smaller than normal, and this way from the clinical picture of dilated stomach observed in cancer of the pylorus and pyloric region. About five of the stomach cancers are found at the cardiac end of that

Diagnosis is usually suggested by the history of dysphagia, and the action offered to the passage of the stomach-tube or bougie, the surging at the point down from the incisors which would correspond to the cardia, according to the height of the patient. When the stenosis is found, further examination should be made with different sizes until the one which passes through is obtained. This gives some idea of stenosis, while the grasping of the shoulders of the tube with olive by the growth will give its degree of resistance. Too much force in passing through a stenosis should not be employed, of the danger of mechanical injury and the liability to subsequentophageal infections—which are very likely to be fatal. In late cases when the growth is irregular in shape the stenosis may not permit the passage of instruments.

In the use of a tube and a suction ball, additional facts pertaining to the presence of malignancy are often obtained. These are small detached particles of the malignant growths; blood, which is altered and fetid but may be fresh and clear (in the latter case it is not so sure a sign); pus and mucus; and long-retained, undigested foods, without the admixture of hydrochloric acid or the contents of the stomach. In obtaining these the instillation of 20 or 30 centimeters of water through the tube and then aspirating this is helpful in securing more significant results.

The use of the X-ray is very valuable in these cases. If a mixture of acacia-barium or rather coarsely cut-up meat (about 4 ounces) mixed with one of the barium salts (about 75 grams) and the entire mass swallowed, a radiograph will usually show a long, sausage-shaped shadow, the lower pole of which is at the cardia. Other plates show a normal-sized esophagus, shortened by the stenosing portion, and a tail-like end representing the upper portion of the channel through which the barium had passed. This meat and barium mass or other mixtures of barium must be swallowed quickly and the exposure made with the patient in the upright position and the plate under the thorax. Another very valuable and perfect measure (although not necessary in most cases) is the use of the esophagoscope, by

## DIFFERENTIAL DIAGNOSIS BETWEEN CANCER AND FALSE GASTRIC TUMORS.

	Tumor (Palpation).	Percussion.	Inspection.	Upon Inflation of the Stomach.
Cancer.	Uniformly hard, irregular or smooth; mass always present and with definite outlines.	Dull over growth.	Local bulging in epigastrium may be observed standing or lying down.	Made accessible or lost entirely according to the position of growth and degree of inflation.
Prolapse of left lobe of the liver.	Soft, shelving, smooth mass. No outline above, definite edge below. Usually not apparent on inspection, but may bulge the epigastrium slightly.	Continuation of liver dullness from thorax to liver edge.	May bulge slightly and over large area when lying down.	Not affected or made capable of palpation. Position not influenced.
Exposure and thickening of the abdominal aorta.	Very deep and vertical running swelling of small size and narrow which pulsates strongly. Close to the vertebral column. Can only be felt in a thin, relaxed abdomen and can be traced downward to the iliac bifurcation.	No change of percussion note.	Not observed. Diffuse epigastric pulsation may be noted.	Usually lost entirely in the epigastrium or impulse becomes more diffuse.
Localized contraction of rectus muscle.	Resistance, with lateral edges running transversely about one and one-half inches and vertically about three. Smooth surface. Not always present, returning and disappearing under examination.	No change of percussion note.	Nothing apparent.	Not affected unless distention is much, when it may display increased resistance for the time being.
Gastric adhesions, and induration of chronic ulcer.	Resistance indefinite. Usually at the lesser curvature or pylorus. Usually very small and is not progressive in development. Does not show the characteristics of above.	No change of percussion note.	Nothing apparent.	Usually masked altogether, returning when gas has left the stomach.

cardiac region or back, and more or less clear fluid may be ejected from the gullet, especially at night when recumbent. The stomach at this late stage of stenosis is usually considerably smaller than normal, differing in this way from the clinical picture of dilated stomach ordinarily observed in cancer of the pylorus and pyloric region. About one-fifth of the stomach cancers are found at the cardiac end of that viscus.

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The use of the X-ray is very valuable in these cases. If a mixture of acacia-barium or rather coarsely cut-up meat (about 4 ounces) mixed with one of the barium salts (about 75 grams) and the entire quantity swallowed, a radiograph will usually show a long, sausage-shaped shadow, the lower pole of which is at the cardia. Other plates will show a normal-sized esophagus, shortened by the stenosing portion, with a tail-like end representing the upper portion of the channel through which the barium had passed. This meat and barium mass or other mixtures of barium must be swallowed quickly and the exposure made at once with the patient in the upright position and the plate under the side of the thorax. Another very valuable and perfect measure (although hardly necessary in most cases) is the use of the esophagoscope, by

means of which the neoplasm can often be seen and a portion of tissue gained for section.

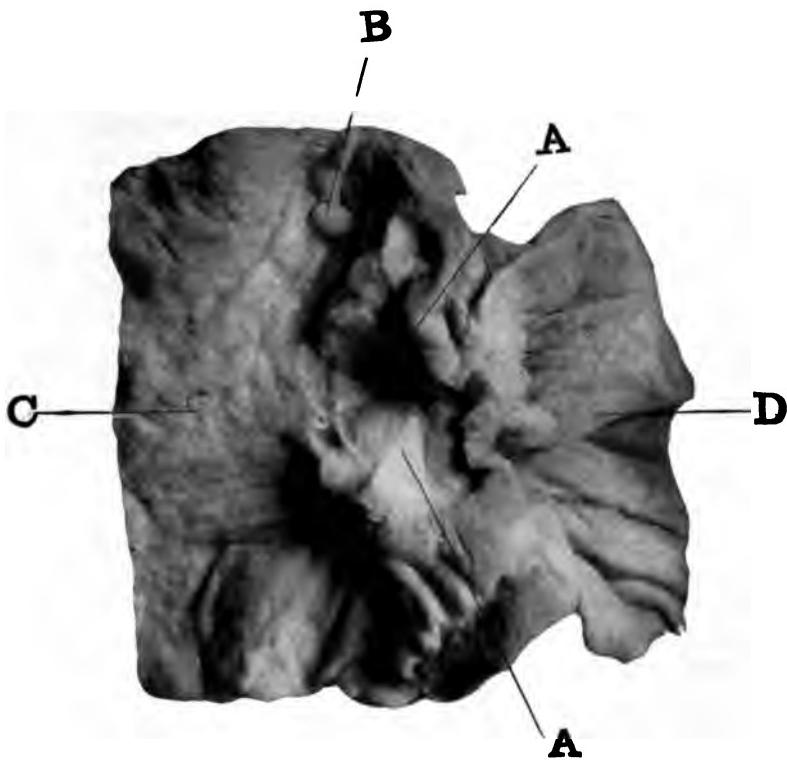
A sign of some value is a delay of over ten or more seconds of the cardia squirting sound following deglutition, and which is heard normally at the cardia in seven seconds. This is tested for by having the patient swallow water, timing the moment of the rise of the larynx, and then, with the bell of the stethoscope at the left of the ensiform, noting when the fluid passes into the stomach. Too much dependence should not be placed upon delays in this second sound of deglutition, because it may be normal even in moderate stenosis, and much lengthened in some persons who are perfectly well. Then, again, it may not be heard at all, or be confused with sounds generated within the stomach. It is sometimes most audible between the spinous process and just inside of the angle of the left scapula.

The existence of a left-sided pleuritis may be of some diagnostic significance in carcinoma of the lesser curvature or cardia. If no other etiological factor for the existence of a left-sided pleurisy or left base consolidation of irregular type (usually a triangular consolidation extending from the vertebral column to the midaxillary line) can be demonstrated, and other symptoms are present which point to the existence of carcinoma, then a suspicion can be entertained that these are the result or due to the presence of malignant disease, usually at the cardia. Cancer occurs at the cardia in about 7 per cent. of the cases, and in about 30 per cent. there is general involvement of the stomach.

**Pylorus.**—Three-fifths of all gastric cancers occupy the pyloric region, or spread out from there. At this site, uncovered in the abdomen as it is, the tumor is usually easily palpable. When the stomach is atonic, the giving of water draws the pylorus down and renders it more accessible for examination. The same rule holds good in the case of distention from foods, although in my experience too vigorous inflation with gas may mask the results obtained from both palpation and inspection. When the organ is displaced downward (ptosis), the pylorus may be much lower than just below the liver in the median line, which is its most frequent position.

Characteristic of growths in the region of the pylorus are the vomiting and the peculiar stomach contents, both of which have been described. These are due to mechanical obstruction to the exit of chyme and its accumulation in the stomach. It may, however, be due to stiffening of the pyloric region from carcinomatous infiltration of the muscle bundles at that site, and, as I have seen on two occasions when the primary growth was in the posterior wall, there would be no actual stenosis of the pylorus itself. In these instances, the entire lumen of

PLATE LXXVI.



Soft glandular carcinoma of the stomach directly at the pylorus. The latter barely admitted the passage of the tip of the finger at post mortem. The stomach contained 260 c.c. of so-called "carcinoma juice." *A*, Carcinoma. *B*, Secondary carcinoma nodules. *C*, Stomach. *D*, Duodenum.



nach is contracted at that point, and this is equivalent to at the valve itself. The vomitus is generally large in amount, in one of my cases to 1650 cubic centimeters at a time.

gnation of foods is a common symptom. This is due to the ion by the growth, muscle paresis accompanying an atrophy, and nce of the hydrochloric-enzymotic function. Foods ingested the ore are often found present in the stomach, and such articles as une, or raisin skins and other substances difficult to disintegrate



Fig. 120.—Photomicrograph of a section of a carcinoma of the stomach involving mainly the pylorus, showing large collections of carcinoma cells between the muscle bundles and also, as the center of the figure shows, the actual infiltration of the musculature itself.  $\times 70$ .

main present in the organ for two days or more. Many of these cases pieces of food will obstruct the eyes of a tube so under it difficult to empty the stomach by lavage. The stomach is usually much enlarged on physical examination, and visible peristaltic movements of the stomach are important symptoms. In other cases they comprise the majority), the organ is small, and the X-ray shows that the lesser curvature and upper wall of the duodenum are crowded upon by the growth. These also show a limitation of the peristaltic waves to the fundic end and greater curvature, and complete absence in the pyloric end, which is stiffened by the tumor.

**Stomach Walls.**—In growths of the stomach proper, the lesser curvature is the most commonly affected. After these in clinical order come those of the stomach as a whole, the greater curvature, the posterior wall, and finally the anterior wall. As the growth encroaches upon the orifices, the clinical picture generally changes. In those of the posterior wall a tumor may not be evident from without, and still the gastric contents be that of a true pyloric stenosis. Evident tumors are liable to be to the left of the median line, and the stomach may be found contracted because of diffuse infiltration; in these instances the chamber is small and its contents little. In practically all of the wall affections, food stagnation is also present, but the food is liable to be in finer particles than in those of the pylorus. When there is a very extensive involvement of the walls the term "leather-bottle stomach" has been applied—a not inapt descriptive term. The esophagus and the duodenum are sometimes involved in these diffuse forms. Tumors of the lesser curvature are not palpable (unless the stomach is low or the growth is of some size), while those in the anterior wall and greater curvature are quite evident early.

#### GASTRIC ANALYSIS.

**Hydrochloric Acid.**—The diagnosis of cancer is often made from the above-enumerated symptoms and findings and the examination of the gastric contents. In addition to the important results obtained in the examination of gastric contents in the way of acquiring knowledge of the dynamic power of the organ, most important are the chemical, bacteriological, and pathological findings. In fact, it may be said that these latter not only confirm but primarily make many of our diagnoses for us. It is unfortunate that the specific trilogy of laboratory findings in gastric cancer—absence of HCl, presence of much lactic acid and large numbers of Boas-Oppler bacilli—usually means a late case, and that some positive and sure means has not been found to make possible an early diagnosis in cases of cancer. Leaving out of consideration the cardia growths and those which occur under a connective-tissue formation—like carcinomatous degeneration of a chronic ulcer—our knowledge to-day and my own belief are about as follows:—

The common absence of hydrochloric acid in gastric cancer was definitely disclosed by Van den Valden in 1879. In a general way it may be said to be absent late in the disease in practically all of the cases of true gastric cancer. In the beginning of the disease in a previously healthy stomach, and for some time during its early progress, it may be found, but—important to note—usually in diminishing quan-

ties as time goes on. In the beginning of pyloric cancer toxic discharge from the cancer may irritate the stomach surface so that the acid content is actually increased. In the end this same toxin destroys the secreting cells, causing a diminution and finally a cessation of the acid-enzymotic secretion. Added to this then, come the bacteria and organic acids and irritations from decomposing foods to further complete the destruction. While the absence of the hydrochloric acid in itself is not indicative of cancer (atrophic gastritis, anachlorhydria), in patients



Fig. 121.—Photomicrograph of a piece of tissue which was found in wash water from a case of medullary carcinoma. The specimen contains practically only carcinoma cells and was observed as a colorless shred almost indistinguishable in the water. Stained with eosin and hematoxylin.  $\times 105$ .

who have reached late middle life and who present other suggestive signs of malignant affection it is a valuable symptom. With the loss of the acid, the pro-enzyme is also found wanting. It has recently been suggested that malignant disease of the fundus and body may be differentiated from that of the pylorus by a quicker loss of the acid than that of the enzymes, pepsin being used to designate this.

Graham and Guthrie, who studied the gastric findings in 150 cases of gastric cancer at Mayo's clinic, reported the following: Of the cases of gastric cancer free hydrochloric acid was absent in only 80, lactic acid was present in but 64, and food remnants in 63. To turn from

figures to comments, it is seen that, while free hydrochloric acid and food remnants are rarely present with advanced gastric carcinoma, in the earlier cases the direct methods of examination may avail us little or nothing. Decided food remnants are of greater significance as a surgical indication than the acid percentages. On the other hand, there are a few cases in which the subjective symptoms are indefinite, and where the test-meal throws the first light upon the pathological condition present. And so gastric analysis, like so many other of our chemical tests, must not be relied upon to the exclusion of clinical factors, but is to be accepted only in connection with careful anamnesis, physical examination, etc.

In the studies of 1000 cases of carcinoma compared with 810 cases of ulcer, Friedenwald presents the following test-meal findings:—

	Cases.	Ulcer. Per cent.	Cancer. Per cent.
Normal acidity was observed in .....	376	46.4	23 3.1
Hyperchlorhydria was observed in .....	246	30.3	35 4.9
Hypochlorhydria and acidity in .....	188	23.2	675 92.0

Of the 733 cases, consisting of 443 males and 290 females, the acidities are as follows:—

	Males.	Per cent.	Females.	Per cent.
Normal acidity .....	16	2.1	7	0.9
Hyperchlorhydria .....	17	2.3	18	2.5
Hypochlorhydria .....	13	1.7	8	1.1
Anacidity .....	397	54.1	257	35.2

While the ordinary method of making the gastric examinations is unreliable, in the early case, there is a method, originally proposed by Gluzinski, that promises better results. Nicolaysen, in writing upon Gluzinski's test in the diagnosis of gastric ulcer, seems to show that this method has real value. It is based upon the facts that ulcer in the pyloric portion of the stomach, with retention, causes hyperacidity; that cancer is attended with a mucous catarrh which causes the disappearance of free HCl; that during the transition from ulcer to cancer there will be found free HCl up to a certain stage of the disease; but during the progress of the mucous catarrh there will occur secretory insufficiency which will be demonstrated by giving two test-meals, one immediately following the other.

The examination proceeds as follows:—

1. The gastric contents from the fasting stomach.
2. A test-breakfast of the white of a boiled egg and 200 c.c. of water, recovered in three-fourths of an hour.
3. A test-dinner of beefsteak and 250 c.c. of water removed three and three-quarter hours later.

The stomach is washed out before and after the first test-meal. The second meal is given immediately after the second washing. The results are: Ulcers—Both breakfast and dinner give distinctly free HCl reactions. Beginning cancer—The first meal gives distinctly free HCl. The action of the second shows only a slight trace of or no free HCl.

Kocher has improved upon this method by determining that the percentage of free HCl in the two meals is present in larger quantities after the second meal in ulcer, while in cancer this meal shows the lowest percentage of free HCl. The value of this method depends upon the increase or decrease in the amount of free HCl in the recovered meals. In 30 cases of ulcer, operation verified the diagnosis in 27; uncertain in 2; 1 showed carcinomatous degeneration of an ulcer, though the test indicated simple ulcer. This test must be taken in connection with the other symptoms and with the history of the case. It can be found that free HCl may decrease in the second meal in diseased conditions of the gastrointestinal canal other than cancer of the stomach, e.g., in gastro-enterop-sis with obstruction. The test is merely one of function showing failing ability of the gastric mucous membrane to secrete HCl. This failing ability may be found in other conditions than in cancer. Further experience is needed to show what are these conditions. In 25 cases of ulcer, but 1 reacted in a manner described by Gluzinski and Kocher, viz., that a decided increase in the percentage of HCl and of total acidity. This fact may be used in diagnosing lesions, not ulcers, accompanied by spesia. For instance, in 2 cases diagnosed as ulcer there was hypochidity, with very little increase after the test-dinner. No ulcer was found at the operation, but adhesions between the duodenum and gall-bladder. Both were cured by the operation. There was found an increase in acidity in duodenal ulcers after the second meal. It was moderate and not marked enough to be made a means of differential diagnosis between stomach and duodenal ulcers. No definite results were obtained in indigestion due to appendicitis.

**Organic Acids.**—Considerably more important than the absence of hydrochloric acid is the presence of abnormal amounts of lactic acid. While lactic acid is present in many normal stomachs (from milk, meats, fish and milk foods), it is only in very small quantities. In these instances, and in some of the gastritides in which the digestion is tardy and the gastric secretion somewhat low, the amount is far too low giving reactions with Simon's modification of Kelling's test or the Fehlmann reagent. The formation of lactic acid in the stomach is pathological, and when it occurs in easily recognizable quantities it is strongly suggestive of cancer.

The method of Boas, to whom much credit is due in the development of this subject, is to employ a test-meal which is free from lactic acid, and when this acid is found in the return fluid, obviously it had been generated in the stomach. For this purpose he employs a soup made of Knorr's oatmeal ingested after a thorough washing of the stomach. One hour afterward the gastric contents are obtained and examined for lactic acid by the Boas method, Uffelmann's test or the ferric chloride solution (Kelling). It must be said that to make this test of more positive value, milk should not be allowed to be taken during the twenty-four hours previous to the ingestion of the oatmeal.

The formation of lactic acid is due to fermentation within the stomach, brought about by the absence of hydrochloric acid and the stagnation of food. Added to this are the influence of the lactic acid bacilli on the gastric contents and the marked diminution of the gastric enzyme.

While lactic acid in excessive amounts is found in about 90 per cent. of gastric cancer cases, it is present in a few of the non-malignant affections of the pylorus (cicatricial contractions, perigastric adhesions, hypertrophic stenosis, chronic ulcer of the aged) where obstruction and fermentation have permitted of organic acid formation. It may also be present under the relative conditions of marked atonia and absence of gastric secretion (enterogastric and gastric atrophy, pernicious anemia, and passive congestion). In cases of early cancer, and in those forms in which the cancer is practically outside of the organ or affecting the mucosa only slightly (ulcus carcinomatous, or small surface growths), the lactic acid formation may not be observed or not until very late in the disease. Thus it is that, like all laboratory tests, its value is in a positive sense, and its absence does not necessarily exclude cancer.

**Tumor Particles and Organic Findings.**—The one pathognomonic symptom of gastric cancer (other than its observation by exploratory incision, to view the growth through the gastroscope or to demonstrate a diffuse growth in the gastric wall by X-ray) is the finding of particles of tumor in the vomitus or removed gastric contents.

These fragments, which are not commonly found, are usually encountered quite accidentally. Search for them should always be made in test-meals and lavage water from all suspicious cases. In rare instances they may be met with before the tumor is palpable from without, but generally they are only obtained late in a case after the other symptoms are quite conclusive. They are usually seen as a film or quite colorless piece of tissue and thus may easily escape observation, or they may be found reddish or brownish in color from blood in their substance. I would suggest the more universal employ-

ment of the practice to run all wash waters through a very fine metal sieve so as to collect all particles from the stomach, whatever the diagnosis of the case may be. In this way, no doubt, more cancer particles will be found. For this, and for the purpose of collecting particles of food from the stagnant stomach, I would advise the use of the sifting pail already described.

In some cases, the diagnosis may be made by the finding of smaller pieces of cancer tissue in the lavage water consisting essentially of a



Fig. 122.—Photomicrograph of a drop of stomach contents in a case of gastric carcinoma with gastrocolonic fistula, showing a mixture of stomach and colon bacteria. *a*, *Bacillus coli communis*; *b*, *Bacillus aerogenes capsulatus*; *c*, Gram-positive diplococci. These three forms are common denizens of the gut; *d*, *Boas-Oppler bacillus*; *e*, Starch substance from the test-meal. The latter two being from the stomach.  $\times 1000$ .

conglomeration of a few cells. It is probable that carcinoma cells are commonly shed in most cases, but one is beset with much difficulty in collecting them. Then there is the great question in the examinations as to whether suspicious cells that are seen are really carcinoma cells or only particles of vegetable tissue consisting of small round cells. It is because of this and the free nuclei normally present from free cells in all stomachs that the clinical value of these examinations is very doubtful. On a number of occasions I have centrifuged wash water in the search for them when I believed they were most probably present,

and other materials (fine food particles, mucus, bacteria, etc.) obscured the fields so that it was quite impossible to be sure that what looked like suspicious cells were positively elements from a cancer. Blood and pus, however, commonly present in cancer cases, are important and valuable findings. Blood is particularly important, especially when it is constantly found in the lavage water. It represents leakage from the growth surface. It is only rarely found in cases of simple ulcer which are well enough to be lavaged. Trauma from the tube may cause its presence (particularly under the influence of retching and straining), but this can usually be obviated or plainly accounted for. The examination of the feces for the presence of blood is positive in about 53 per cent. of all cases of gastric carcinoma, and a higher percentage than that in malignant disease of the intestine. The pus usually is not fetid, and is due to ulcerous destruction of the cancer surface.

The microscopic examination of stagnant gastric contents in cases of cancer is most important. Naturally, food particles, especially meats, are quite common. And when taking into consideration the time of their ingestion, the appearance of them in quantity is confirmatory of stagnation. The giving of raisins the evening before and observing if the skins are present in the morning stomach, as shown by Mayo, is a simple and valuable method of noting stagnation. Yeast and molds are generally absent, while the presence of cocci, either staphylococci, streptococci, or diplococci, is a common picture. These, of course, are suggestive of ulceration, a condition, in my opinion, which occurs early in many gastric cancers. The sarcinæ are rarely met with in a late case, and when they had been present in an ulcer case and are no longer to be found, particularly if the pains or stomach distress had decreased about the same time, it is strongly suspicious of carcinomatous degeneration and operation is indicated.

A frequent constituent of the microscopic picture of stomach contents is the presence of numbers of large-sized, non-motile organisms called the Boas-Oppler bacilli. They are seen as long, rod-shaped bacilli, found in running formations, or they may be seen detached from one another and lying in all directions like small sticks, or they may join each other in a zigzag order. In length they are from 6 to  $8\mu$  and are about  $1\mu$  in thickness. They are anaërobic and occur without the formation of spores. When viewed under a cross-light, plain or when but slightly stained, they present a shiny, hyaline appearance. The bacilli are capable of coagulating milk and generating lactic acid from various sugars, and may therefore, according to Boas,<sup>4</sup> be looked upon as the main or one of the inciting factors of lactic-acid formation in the stomach. They are quite constantly found in carcinoma when

lactic acid is present in excessive amounts, and are almost always absent in any amounts in the non-malignant affections. The organism is readily stained with the usual aniline stains and is Gram-positive.

When lactic acid is found, the lactic acid bacillus is also present. In doubtful lactic acid reactions its presence is of some significance. The presence of the lactic acid formers—lactic acid bacilli and the Boas-Oppler—is not as valuable clinically as the presence of lactic acid itself. I have observed cases of cancer where it was impossible to be



Fig. 123.—Photomicrograph of a drop of gastric content aspirated from a case of carcinoma ventriculi showing the Boas-Oppler bacilli. Stained with aqueous methylene-blue. X 700.

sure that these organisms did or did not exist and still lactic acid was present in easily determinable quantities.

A test of the gastric filtrate for carcinoma of the stomach has been advanced by Neubauer and Fischer. The principles upon which it is based are, that the digestion of proteins proceeds farther in a carcinomatous stomach than in a normal one, due to the presence of an enzyme from the carcinoma which is analogous to trypsin in its action, and that the amino-acid tryptophan in peptid combination as glycyl-tryptophan cannot be digested by pepsin and does not give a color with bromine; when the tryptophan is split by a tryptic ferment (such as the one from a carcinoma) a reddish color results when the bromine vapor is added.

The test is performed by first thoroughly purging the patient, the patient eating a cold test-meal the next afternoon which is extracted in the stomach over an hour, testing same first for the presence of blood, mucus, and pus, and if these are negative, then filtering and testing the filtrate with bromine vapor, and, if this also is negative, proceeding as follows: 11 cubic centimeters of the filtrate are added to 2 cubic centimeters of glycyl-tryptophan solution, the mixture is covered with a piece of glass and placed in an incubator for twenty-four hours at 37° C. At the end of this time about 3 cubic centimeters are removed with a dropper into a test-tube, a few drops of a 3-per-cent. solution of acetic acid are added, and the bromine vapor gently blown down the side of the tube in small amounts at a time so as not to color the filtrate with it directly. If tryptophan is present, a color develops which varies from yellow to a deep red violet and the test is positive.

Sufficient time has elapsed to draw definite conclusion as to the value of this test which the author believes to be a more valuable one for cases of cancer than the Solomon test. Up to the present, I have used this test in the examination of over 2000 test-meals from 1768 cases (all of which the HCl was low or absent). Of these, 271 were cases in which the diagnosis of carcinoma was made, and in 133, operation or autopsy proved the correctness of it. In these 133, the test was positive in 76 cases in 77 cases, slightly less than 50 per cent. In the other 76 cases it was negative, and in a few positive at one time and negative at another. Of the 1497 remaining cases, 116 came to operation in which the stomach was opened, and, although 27 of these gave positive results, no carcinoma could be demonstrated. Thus, in only one-half of all the cancer cases was it present, and in one-fourth of proved non-cancerous cases it was positive also. The reason for its absence in one-half of the cases was probably that almost all of these growths were very exophytic and non-purulent, there being too little or too fibrous a formation in the mucous surface of the stomach to secrete the necessary ferment for the test. The reason for its presence in the non-cancerous cases was that, as has been shown, an enzyme existed in the saliva which can split the dipeptides into the dipeptid, or else the lactic acid bacilli, yeast, and fungi do this instead. I acknowledge the presence of a peptidase enzyme in cancer juice, but, since many of these growths are non-acidic and you cannot exclude the effects of the saliva (which is low or non-acid stomach of a non-cancerous case, the test has little appreciable value in the diagnosis of cancer of the stomach. Amongst the experts of the pathogenicity of this test continued favorable (as in 2000 confirmed cases), my results with it are far from as favorable (indeed to this is the doubt that is always present when a positive result is obtained).

tive result is obtained, the length of time the test requires for its careful performance, and the expense of the glycyl-tryptophan solution. Great care is necessary in making the test that certain influencing factors are eliminated. Tryptophan may be present in normal stomachs; therefore, it is necessary to test the filtrate with the bromine vapor *before* the test is instituted. The presence of blood and regurgitated pancreatic juice must also be eliminated, because the first contains a proteolytic ferment which can split the peptid, and the second the ferment trypsin itself; therefore, the necessity of the chemical tests to note the presence of occult blood, and the macroscopic or Gmelin test for bile, and the hydrated starch test for amylopsin. Neubauer and Fischer state that 0.36 per cent. of hydrochloric acid in the stomach will render the test negative; therefore, if more than this amount of the acid is present, the filtrate from that test-meal cannot be used and another test-meal should be extracted with which an alkali was given at the time of ingestion. Lyle and Kober advise care in drawing negative conclusions when the acidity is over 12 or 15 degrees, and also that in all instances the hydrochloric acid acidity of the filtrate should be neutralized immediately after extraction with magnesia usta; the author has used a normal solution of sodium hydrate for this purpose and found it satisfactory, litmus papers being used as indicators. The Weinstein modification of the test is only one-third as reliable as is the original.

A test for the diagnosis of gastric carcinoma about on a par with that of the glycyl-tryptophan, and decidedly less expensive and quicker to perform, is that of Oppenheimer's. The procedure is the following: Forty minutes after an Ewald breakfast, the stomach is emptied and the contents filtered. To the clear filtrate add 3 per cent. acetic acid cautiously, a drop at a time. In case the reaction is positive, a turbidity or cloud appears, which vanishes only after considerable acetic acid or a little hydrochloric acid is added. Dilution with one to five volumes of distilled water causes the cloud to remain. The only source of error is mucus, which also gives a cloud with acetic acid; but this cloud is unaffected by the addition of a few drops of HCl and does not occur in high dilution of the gastric contents. If the gastric filtrate is so turbid that dilution with an equal quantity of distilled water does not clear it, the acetic acid test cannot be employed. Slow filtration through a wet, folded filter usually yields a clear filtrate. The test may be applied to vomitus, and blood and pancreatic juice are not disturbing factors, as in the glycyl-tryptophan test.

Fuhs and Lintz have recently advanced a urinary test which I have observed positive with some constancy in well-established carcinoma cases.

Unfortunately the urines of some of the rheumatism, nephritis, meningitis, and almost all of the late pregnancy cases give positive results. But when there is any doubt as to whether a pathological condition existing in any of the viscera of the thorax or abdomen is cancerous or not, and when the above-mentioned conditions can be ruled out, the test may be helpful in drawing attention to or helping to confirm the diagnosis of malignancy. The test as described by them is as follows: "Methylene-blue—we generally use 3 to 5 drops of Löffler's methylene-blue—is added to a test-tubeful of fresh urine; sufficient aniline dye is used to give it a decidedly blue color. The urine is shaken and then allowed to stand at room temperature for from twelve to twenty-four hours. A control fresh specimen of normal urine similarly treated is made. At the end of said time the blue color of the urine disappears; the upper layer, however, which is in contact with the air, still remains more or less blue. The control specimen, on the other hand, remains unchanged, retaining its uniform blue color." The test is of no value in high bacterial urines and particularly those that are ammoniacal, because reduction of the color always takes place and quickly. Then, again, urines from normal persons and those in other conditions than malignancy may give positive results. My experience has been that one should hesitate considerably before attaching much significance to a positive reaction by this test in a doubtful case of malignancy.

Last and really of very much importance in diagnosis is the use of the X-rays in noting irregularity in stomach outline in localized areas, usually at the pylorus and the lesser curvature (in which locality the investigations of Peterson and Colmers show that a carcinoma displays a marked tendency to extend within the stomach wall itself). According to Holzknecht, gastric tumors indicate their presence in the skiagraphic picture in one or more of the following three ways: (1) They cause the appearance of what look like empty spaces or defects in the current of the mass in the stomach; (2) they cause the appearance of abnormal boundaries of the stomach mass; (3) they produce irregularities of peristalsis. Kuttner doubted very much whether X-ray investigation provides any information that cannot be determined by other means of investigation, but this is not universal experience. In the main, up to recent times with the slow types of generators used, this was true. But to-day this is not so, for there is much of significant diagnostic value in the sharp pictures that are now possible. Still, I wish to caution against making diagnoses from one or two plates alone without sufficient clinical data to substantiate them. It is now my practice to make at least three sets of plates (one of entire stomach and one of the pyloric region alone), on three different occasions of about four-day intervals, and then

compare all of these to note if the findings observed in the first set are duplicated in the later ones. By this method there is much valuable information to be gained by the X-ray method of examination, and the dangers of mistakes in diagnosis are minimized to almost *nil*. One who has had sufficient experience with a fluoroscope can easily make diagnoses without plates when the growth is of some size or the fixation of the stomach distinct.

#### DIFFERENTIAL DIAGNOSIS.

The diagnosis of moderately advanced gastric cancer resolves itself into the diagnosis of the attachment of a palpable tumor (whether gastric or not), whether the mass is malignant or benign, and between cancer and other gastric diseases.

The diagnosis between cancer and false tumors has been described (page 676). Whether an existing tumor belongs to the stomach proper, and if so to which portion, or to the surrounding organs is not always easy. Clinical points on this are offered in the list on following page:—

The subject-matter pertaining to benign tumors is treated further on. It may be said that as a class they are conditions not accompanied with illness, and death is rarely due to them excepting possibly in an indirect way. They are uncommon affections and are rarely diagnosed during life. Gall-bladder conditions, thickenings in the stomach and adhesions about the pylorus may mimic a tumor. It is natural to understand that any formation which has existed for several years is not likely to be a cancer.

The main clinical work is concerned in the diagnoses between cancer and other gastric diseases of a pronounced nature. The following are those conditions that may be confounded with it and which are found treated in more detail in the chapters on these diseases: Ulcer (particularly chronic); chronic gastritis (particularly atrophic); gastric ectasia; pyloric stenosis, acquired and congenital; stenosizing hypertrophy of the pylorus; neurotic states of absent and deficient gastric secretion; severe forms of neurasthenia gastrica.

**Ulcer.**—The onset of symptoms in ulcer is usually more acute and the pain more piercing and agonizing than that of cancer. The pain is usually intensified by the taking of meals, and relieved when the stomach is empty; in malignant disease the pains are not much increased by the presence of food in the stomach and are present all of the time in about the same degree of severity. The tendency of the ulcer cases toward recovery makes the history of pain and that of hemorrhage of shorter duration. In chronic ulcer, however, the pain may continue over a long

**Tumors.**

	<i>Inspection.</i>	<i>Percussion.</i>	<i>Palpation.</i>	<i>On Inspection of Intestines.</i>
1. Stomach. Pylorus.	Commonly observed in epigastrium in or near the median line. Circumscribed.	Dull.	Easily felt.	Moves upward.
Anterior wall and greater curvature.	Usually prominent, especially when stomach is distended. Circumscribed.	Dull.	Easily felt.	Moves upward.
Lesser curvature.	Not observable.	Questionable.	Not felt.	Moves upward.
Cardia.	Not observable.	No change.	Not felt.	Moves upward.
2. Liver and gall-bladder	Indistinct. General fullness, or not observed.	Dull. Gall-bladder growths very questionable.	Easily felt.	Entire organ lifts, protruding the edge.
3. Spleen.	Observed when very large.	Dull in abdomen.	Easily felt.	Moves upward and to left.
4. Pancreas.	Rarely observable, and only under extreme emaciation.	No change.	Indistinct and difficult to feel.	Usually masked by the colonic distention.
5. Colon.	Rarely observable and only when quite large in an emaciated abdomen.	When large, dull. When small, no change.	If of some size, can be felt.	Becomes more prominent and remains stationary.
6. Kidneys.	Not apparent, even when quite large.	No change.	Not difficult to feel.	Obscured, unless low in the abdomen.
7. Great omentum.	Long, transverse, diffuse swelling in thin subjects (tuberculosis, cancer).	No change.	To be felt, usually as a rather deep resistance of some area.	Moves downward.

time. In these, hemorrhage and certainly continuous bleeding are quite uncommon. In acute ulcer the characteristic front and back pain areas are found, while in cancer the pains are more diffusely distributed. The tongue in ulcer is clean, while that of cancer is often thickly furred. Ulcer patients usually are well nourished and fail in health and strength but very slowly or not at all, the appetite remains good, and no real aversion for food exists. The gastric findings of increased or normal amounts of hydrochloric acid and enzyme, very little or no stagnation of foods, no increase in the amounts of organic acids, no Boas-Oppler bacilli, also the prominent feature of hypermotility showing but little remains of a test-meal in a short time are suggestive of ulcer. Mucus is usually scant in the ulcer cases and no tumor presents itself, even after a length of time. The X-rays are helpful in differentiation.

**Chronic Gastritis.**—When this is of the atrophic form, the finding of gastric cells is pathognomonic of chronic gastritis. The long history of dyspeptic disturbance with cause for its origin, the finding of much mucus in the test-meal, and the very chronic state of the illness are important. Most cases of chronic catarrh improve substantially under appropriate treatment and the local symptoms and the general health recover; in cancer this does not occur. Actual pain and hemorrhage are practically not observed. Gastric digestion may be tardy, but marked stagnation of foods is rarely seen. Gastric secretion may be low, but the organic acids in great excess are not observed and the fermentation organisms are absent or very few. Steady observation of a dubious case will usually clear up the diagnosis. Absence of tumor and the history of intermissions are also important points. The X-rays are helpful in distinguishing the two.

**Gastric Ectasia.**—This refers to the primary ectasias accompanying the benign affections of motility and secretion, and disturbed constitutional states of health (debility and blood dyscrasias). Also, to the secondary dilating effects on the stomach of pyloric spasms. The primary ectasias are diagnosable by a general consideration of the symptoms, the discovery of disturbed states of motility and secretion, the absence of the characteristic cancer symptoms, and the improvement in the condition under appropriate treatment. They are not (as a class) accompanied with actual loss of the gastric secretions, marked stagnation of foods, high degrees of fermentation in the stomach, very much loss of weight, hemorrhage, actual pain, etc. The pylorospasms and disturbed general states of health are diagnosable in their own individual ways.

**Syphilis.**—Not a few instances of this disease of the stomach are diagnosed as cancer. There may be a palpable mass, an achylic stomach

with organic acids and Boas-Oppler bacilli and many of the symptoms already mentioned. The X-ray plates may strongly suggest malignant disease, and unless one keeps the possibility of syphilis in mind, mistakes are liable to happen. The three distinguishing features however are that the individual has a more chronic or longer history than generally goes with malignant disease and the general condition in loss in weight and anemia is not so marked. The second is the presence of a positive Wassermann reaction, and the third the marked benefits that accrue on antisyphilitic treatments. When a Wassermann test had not been made, it is wise to always try a course of antisyphilitic treatment in what appears to be a malignant condition of the stomach.

**Pyloric Stenosis, Acquired and Congenital.**—In the acquired forms, a definite or suspicious history of past gastric ulcer is common. After this there usually follows a more or less mild run of gastric disturbance of the subjective kind. Hypochlorhydria is common, but an achlorhydria with lactic acid formation may exist when cicatricial contraction or binding perigastric adhesions have obstructed the pyloric region for a long time. The rapidly progressive history of cancer is absent, and the case is of the chronic order. Tumors are rarely or only very questionably palpated, dilatation, stagnation of food and fermentation are only moderate, and hemorrhage is uncommon. In the congenital forms the history of disturbance in early life is valuable. The X-rays show the large, globular stomach.

**Hypertrophic Stenosis of the Pylorus.**—This is a long-standing affection, usually with a cause such as alcoholism. It begins with a history of chronic gastritis, and the gastric dilatation is not marked or may be absent. The tumor is small, round, and remains about the same size after once observed. In most cases, the presence of the tumor is first observed at autopsy. There is usually a history of alternating improvement and aggravation of the symptoms, although the history and gastric findings may be such as to make a diagnosis between this condition and cancer quite impossible unless careful X-ray observations are made. Late cases of unrelieved hypertrophic stenosis are particularly liable to be looked upon as cancerous, particularly when shallow ulceration is present, continuously giving occult blood in the stools. The condition is rarely met.

**Neurotic States of Absent or Deficient Gastric Secretion.**—These are diagnosable by the presence of good states of general health, evident causes for their production, their alternating history, the absence of the characteristic gastric findings of pyloric stenosis and malignancy, and their quick and progressive improvement under proper treatment. In the anachlorhydric and achylous disorders, although secretion is absent, the stomach may empty in good time.

and a non-progressive simple atonia exist without much if any real dilatation. The stomach is empty in the mornings, and hemorrhages are not found. The tongue is usually clear.

**Severe Forms of Neurasthenia Gastrica.**—General symptoms of neurasthenia or neurosis are common. The condition is commonly found in early middle life, and the motor and secretory functions of the stomach are not suggestive—although absence of hydrochloric acid



Fig. 124.—Case of hydatid disease of the liver in which the prominence in the upper epigastrium simulated a mass of carcinoma of the pylorus.

may be observed for a short period. The cases are usually somewhat chronic, and do not progressively get worse, either locally in the stomach or generally in the body. Continued observation usually clears the diagnosis.

Gall-bladder conditions usually give no trouble in differentiation, and the same may be said of chronic appendicular disease. In chronic pancreatitis the indefinite history, chronicity of the affection, and the examination of the stools are usually suggestive.

**DIAGNOSIS OF EARLY GASTRIC CARCINOMA.<sup>44</sup>**

It is practically and universally agreed that surgery offers the only possibility of cure of cancer. The only cases in which life is maintained years after are those in which malignant tissue has been totally removed. This is only possible when the disease is not advanced and is definitely local. Thus it is essential that a diagnosis be made as early in the course of the disease as possible.

Considerable criticism has arisen from surgeons that earlier diagnoses are not being made. This is not entirely justified because cancer begins as a small nidus and is not always preceded by an ulcer or any status of indigestion, and it is generally not until marked advance has taken place that the person comes under observation. The writer has lately seen three such cases in practising physicians; if they are encountered in members of the profession, how can one expect more watchfulness from the laity? In one of my cases, the man had a large practice and was a surgical leader in his community and abreast with medical progress. He believed he was run down from work and went away for a rest and then took tonics because his rest had not benefited him and finally quinine, because he thought he had malaria. He happened to put his hand on his epigastrium one night and felt to his surprise a large mass—almost the entire stomach being involved. The criticism of delayed diagnosis is unfair, particularly when this has been met with in more than one instance. If it were not for the discharge, many uterine cancer cases would not come under observation, and the same is true with lumps in cancer of the breast and elsewhere.

There is, however, another side to this matter. Some cases that I have seen have been temporized with too long without a substantial diagnosis by some general practitioner. It sounds like a cheap cry of alarm, and one far too sweeping as a general policy for the general practitioner, to say that every case of "indigestion" in a person of cancer age should be diagnosed away from cancer if the symptoms have lasted a few weeks, even though they had apparently responded to treatment. Yet this disease is so insidious that it is impossible to differentiate unless one has made a policy of diagnosing away from cancer rather than trying too late to explain a stationary or downward course of the patient's health. A well schooled clinician recognizes what may be called an elasticity in diseases and conditions that are not progressive to fatality—a something that while it may apparently be absent, nevertheless is an asset that can be built upon to restore health. This does not exist in cases of cancer and whatever the diagnosis of the condition or cause of the indigestion may be or whatever the treatment and the immediate result obtained, the

foundation stones upon which health might be built are missing. It is only a question of time for this to be manifested to even the most casual observer. Because of the propaganda against cancer, and Bloodgood deserves much credit for recent work in this, and also a broadening interest in abdominal conditions, general practitioners everywhere are making better diagnoses, and not a few are well abreast of the subject. It is a very encouraging sign that this type of general practitioner is becoming more and more numerous. It augurs well for the future of American medicine and respect for the profession.



Fig. 125.

Fig. 126.

Fig. 125.—Looking into the pylorus from the stomach side. The darkness of the lower half of specimen due to blood in the mucous membrane of clamp trauma. Arrow points to greatest thickness of growth, on each side of which specimens were cut for microscopic examination. No macroscopic evidence of cancer in the mucous membrane. The growth involved only the lower left quadrant.

Fig. 126.—Posterior wall of the stomach, cut stomach to the left, lesser curvature to right, greater curvature above. Duodenum upper right apex. Arrow points to site of growth. No evidence of peritoneal involvement, glands, metastases, etc.

In a case of early cancer of the stomach, the diagnosis as far as indication for surgery is concerned is usually not difficult. Sufficient intelligent investigation is the most necessary factor in the vast majority of instances. Go after the diagnosis directly and diagnose away from cancer, rather than begin with a hazy idea of all the abdominal troubles. It seems extreme, but it is wisest to suspect cancer in every patient over thirty-five years of age in whom symptoms have persisted for a few

weeks. Take a positive attitude as a basis of departure. In Anglo-Saxon countries an arrested person is innocent of a crime and must be proved guilty by prosecuting authorities; in France he is judged guilty when arrested and must prove his innocence. This is somewhat analogous to what I believe should be the point of departure in diagnosis of cancer.

It is stated that in only 2 per cent. of chronic ulcer cases does clinical cancer develop. The pathological reports from the Mayo Clinic indicate that this figure is far too low. Hence a large number of ulcers with microscopic findings suggesting malignancy never develop clinically into what we understand as cancer. Judging from histories of cancer cases I have seen, in the vast majority there is no history of ulcer. Of course so called precancerous lesions of the stomach may have been present without symptoms, but this is a point yet to be proved as far as gastric cancer is concerned. Our reasoning for the premises commonly taken here is based upon what we know of cancer following chronic lesions in visible parts of the body, and considering all lesions the number of cancer cases are few. I cannot prove the contrary of Mayo's contention, except in a gross clinical way, so I still feel that Ashoff's beliefs are best. The question why in one person cancer develops from a lesion and does not in another has yet to be answered. To the clinician there is a susceptibility to this disease in some persons, and this susceptibility when present may even influence the character of the neoplasm primarily and the course of it both locally and generally. It seems true that the vast majority of the people who have suspicious histories of chronic ulcers are resistant to cancer and do not acquire it, no matter how long a gastric ulcer had existed or how much neglected. We all agree that surgery is the proper procedure in all persistent ulcers, and that the effort should continue to render possible their cure by surgery, both from the standpoint of relief of symptoms and because in a small number of the whole they are precancerous lesions. One cannot tell, however, at the time of examination of old ulcers which person is susceptible to malignant disease and which is not. To feel that all or only one-half of the unhealed ulcers are or will become true cancers, is reaching far into the realm of supposition, for the opposite has been proved by clinical facts. It is hoped that in the future some laboratory test for susceptibility to cancer will be found, such a test as valuable for cancer as is the Wassermann, luetin, or spinal fluid test for syphilis. If only a test for susceptibility were available, much of the mystery in the ulcer cancer problem and in cancer elsewhere in the body would be tremendously cleared up. If cancer were an infective condition, it is probable that its cause would have become known with the development of ultramicroscopic methods and a test discovered. Practically all of the most important diseases of man are now in the class of

infections, and laboratory procedures for their diagnoses are based upon the fact that a definite infection exists.

Up to 1914, 320 cases of gastric cancer had been examined by me. In these a history strongly or mildly suggesting ulcer was met in sixteen cases, or about 5 per cent. Of these cases 287 were deemed good or fair enough for recovery from the immediate effects of exploratory incision, although after a negative Wassermann, operation was advised in all. It was advised also with a positive Wassermann, pro-



Fig. 127.—Showing collection of carcinoma cells in deeper and denser portion of the organ.

viding a short course of antisyphilitic treatment had not helped. One can never tell even in what seems to be a late case whether an operation might not be of some assistance, and thus the best plan is to do at least an exploration in all. Of the 287 cases, 192 were operated in, and in the ninety-five remaining, there were two factors against it. In sixty-four, physicians advised the patient against operation—a most unreasonable and unwarranted attitude for any of us to take positively—the patients themselves declining operation in the remainder. Of the 192, in fact in 279 of the whole, all are dead as far as I know, my records being complete in 259 cases; the remaining twenty I was not able to trace. Of the whole number there were eighty-one cases in which I felt that surgery

offered distinct possibilities of benefit, seventy having been operated in. It is a discouraging record for any conscientious physician that after all this work all the patients are dead, although in many a prospect of distinct benefits and lengthening of life had been looked for. In but eight cases was the possibility of complete cure marked, and the deductions from these eight are the special occasion for this article. Extensive excision was done in every one of these patients, in four with the removal of glands. Two of the latter had return of the growth locally in the stomach; one is dying at present, and the other will not live much longer. At any rate, they all lived practically three years after the diagnosis and operation and were useful members of society during most of that time, a result I feel would have been impossible unless operation had been done. Of the six remaining, one now has an extensive carcinosis of the abdomen, and will die shortly, and another had a cancerous breast removed three months ago but is now apparently quite well. Four are to-day well, and these, too, were primary cancer cases, not questionable ulcers.

The early examination in these eight cases showed obstruction at the pylorus and definite gastric symptoms due to the persistent obstruction and not to the cancer in any way. Of course, the obstruction was due to cancer, but the point I wish to make is that they came under observation for symptoms due entirely to the pyloric obstruction. The laboratory findings with test-meal examinations proved this in all, and the X-ray in all but one. In one, traces of blood in very small amounts were found frequently in test-meal and stool. In the rest this was negative. Hydrochloric acid was present in all but one, two having a distinct hyperacidity. In the one in which acid was not found, there were traces of organic acid and a very occasional Boas-Oppler bacilli. In one of the hyperacid cases I had the opportunity to do three extractions in eleven days, suspecting, after the X-ray had suggested the diagnosis, that the normal acid content would run down, but it did not. In all there were more than five hour delays of mixed meals; in five it was over twelve hours. The Wohl-Junghaus test was made in seven, was negative in six, and questionable in one. None had Saxyl-Solomont urine. Thus it is plain that so far as the history and the laboratory examination were concerned, only pyloric obstruction could be diagnosed.

The X-ray was more definite in all but one. In seven instances it showed a distinct defect in the anatomy and over six hour stagnation. Its greatest value to me is in the defects shown; I am firmly convinced that the direct method of X-ray diagnosis is dependable. In these instances, encroachment on the lumen defects, definite tenderness to pressure upon these areas, peristaltic wave jump areas, and deformities were manifested. All but one had pyloric obstruction of permanent kinds.

confirming the laboratory findings. The value of the X-ray was in confirming the laboratory method in diagnosing stagnation. What the laboratory could not show was the anatomical defects, and because of this, the X-ray method takes precedence over the laboratory, although the latter should not be neglected. In one case as normal a stomach as was ever observed by X-ray was seen—no defects, no jumps, no anything—yet the history was suspicious. The laboratory was more valuable here than the X-ray in that blood was demonstrated in the test-meal and stool.

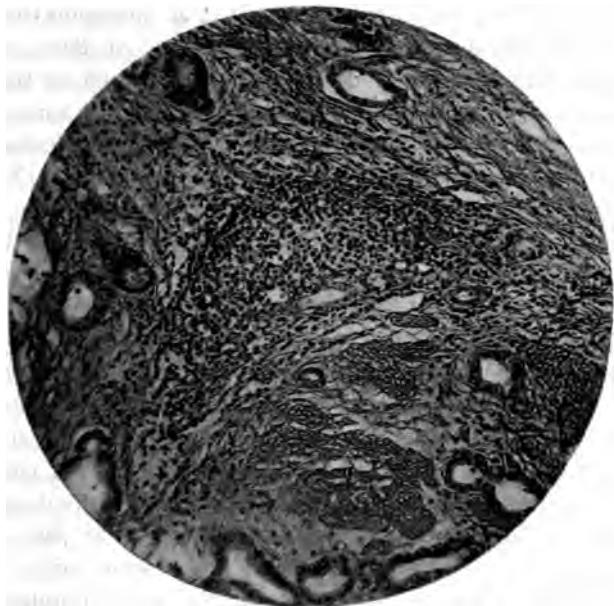


Fig. 128.—Carcinoma cells invading mucous membrane and submucous tissue in a case of early gastric carcinoma.

Most important of all, however, is the history. In the play of the different forces contending for recognition and supremacy in the advance of medical science, this matter is receiving less attention. While the laboratory and X-ray offer in this, as well as in many subjects in medicine, most valuable service as a method of diagnosis, neither one is complete in itself. There are services in the completion of a diagnosis that they, and only they, can give—additional facts on which to base a definite decision. The history, however, should take precedence. It is unfortunate that the easiest and the least time and expense consuming method of the three is so slightly regarded by an apparently constantly growing number of our colleagues. In every one of these cases details in the history, simple phy-

sical examination, or both suggested an obstruction of the pylorus, one that had not existed long, but was permanent in type and mildly affecting the general health. While the X-ray usually showed the defect, the history was more suggestive of its nature than either the X-ray or the laboratory. In the history one deals with an individual and that means dealing with disease far more directly and dispassionately than the two indirect methods of laboratory and X-ray. Manifestly, the most direct method is to operate, but the victims of the early manifestations of disease have not got operation primarily in mind. This must always be suggested by the examiner and reasoned out with the patient. It is at this point that the history is important, because this is the foundation of later symptoms. Symptoms bring the case under observation. Inasmuch as the field of abdominal diagnosis is large and the number of cases of cancer is comparatively small, histories are very important. If I were deprived of any two methods in the four of history and physical examination, X-ray, laboratory, and operation, I would prefer the first and second. The best service, however, is to be had in diagnosis of early cancer by all four, in which history is of the first importance. I state this after considerable experience with all. Why histories are being neglected in abdominal work is beyond me.

I offer a division of the early gastric cancer cases into two main groups: Those which are not situated at the orifices and those which are. In those not situated at the orifice practically none, excepting possibly the few ulcer cases, will be diagnosed early enough for cure. They have no local symptoms until a large part of the stomach is diseased, and then the symptoms are general as well as local, as in all late cases. A few of these patients, however, come under observation fairly early and they should be operated upon, but in by far the larger number they do not come to any medical man until marked extension of disease is present. The second type are those at the orifices, pylorus, or cardia, and these are more fortunate. Suggestive and pronounced subjective symptoms come on quickly and are often distinct enough to see in a history, however casually given: the slight nausea, coming on perhaps only late in the day; the bitter taste suggestive of a stagnant stomach; the occasional vomiting of foods retained from the previous meal or even before this, although this is a late symptom; the relaxed stomach, and possibly its visible peristalsis if sufficient tone is still present and the obstruction is distinct enough. With these are also the danger signals of anorexia and perhaps aversion to meat; neither are pronounced in the early case and only suggestively present. All of these serve as beacons on the trail, although the lights may be only barely visible in the darkness. When the lesion is at the pylorus, distress is felt in the median line and is made worse by taking

food, there is tenderness on pressure, perhaps spasm, and an unexplainable weakness becomes manifest and gradually increases. When the growth is at the cardia, there are difficulty in swallowing never before present and attendant esophageal distress which may be minor in nature, yet definitely present.

If an early case has come under medical observation, why wait until anorexia, vomiting of stagnant contents, loss of weight and strength, anemia, cachexia, a mass, and so forth are present? Recourse should be taken promptly to the X-ray and the laboratory long before these manifestations set in, and then a frank statement to the surgeon and to the patient of your beliefs should be made. In all of the cases I have diagnosed early, I believe it was possible for anyone who is watching and careful in his work to recognize the condition. It is the obstruction, or delay of total stomach contents in fixed time, that I wish to emphasize particularly, since all of my early cases had it.

**Hemorrhage.**—This is usually slight, is but rarely seen directly, and almost always occult. The expression method of extracting stomach contents must not be resorted to—it is too liable to produce trauma—but just a simple aspiration with suction enough to overcome the force of gravity and to raise the meal through the tube. The bottle I have devised serves well for this purpose. If retching occurs during the process, the presence of blood is of no value in the diagnosis, and should be discounted. We should not be anxious to empty the stomach at these times—from 10 to 20 cubic centimeters will be sufficient for these examinations. When a patient strains continually and in all conditions, and our suspicions of malignancy have been aroused in the case, a few meals may be extracted under nitrous oxide anesthesia. When blood is constantly present in meals extracted twice a week, be on your guard—it is more liable to be cancer than ulcer, or of no significance. This symptom is found in about 20 per cent. of the early cases, and its absence does not necessarily exclude cancer, since in about half of the cases of this disease hemorrhage is not observed in the vomitus even late, but still in many of these blood in small quantities is present in the stomach even from an early date. Examining the feces for blood in these early cases is of no value—the bleeding is too small in quantity, is absorbed, and thus not liable to give the reaction. Be careful not to permit the taking of meat foods for twenty-four hours preceding the taking of the test-meals. Washing the stomach immediately before the meal is taken or even the night before is inadvisable. Lavage of the empty stomach and examining the water for blood is not as good as the test-meal method. The presence of the meal in the stomach for a long time, the

gastric motility and secretion, and normal increase of blood within the stomach walls during digestion encourage bleeding from the free surface.

**Pus-cells and Bacteria.**—These come next in significance. Pus-cells are not products of a normal stomach, and when they are found (excluding those which may be swallowed in sputum from the oral cavity or be formed in the stomach in phlegmonous gastritis) they are indicative of ulceration. In my experience, they are found in the stomachs of early cancer, proving, I believe, that ulceration is common in early malignant growths. They are not very numerous and rather difficult to discern in the test-meals. Lavage or extraction after ten minutes of normal saline instillations and centrifuging the return fluid give the best results. The cells are sometimes found in dense conglomeration, suggestive of a slough from an ulcerated surface. When these cells are regularly found, and particularly when red blood-cells are also present, be on your guard. With them, the bacterial flora of stomach contents are also increased. The cocci seen are either the staphylococci, streptococci, or diplococci. A common type of organism which may be markedly predominant is a streptobacillus. Loops from the test-meals inoculated into dextrose-bouillon suffice well for the bacterial examinations when doubt exists. The presence of what may be considered as increased numbers of micro-organisms can be judged only in the relative sense. They are found in test-meals from non-malignant and normal stomachs, and their nature, whether suppurative or not, is difficult to detect. But when one type of them largely predominates, and is constantly present with blood- and pus-cells, they are of much significance. The Boas-Oppler bacilli are found late in cancer, but when noted in gradually increasing numbers are most suspicious.

The presence of minute particles of tumor tissue may be found and perhaps be conclusive. These are very uncommon in early cases. The same may be said of loose tumor-cells, which are always doubtful in their nature—they resemble the free nuclei of normally digested free cells too closely for definite conclusions.

**Hydrochloric Acid.**—In the beginning of cancer in an otherwise healthy stomach the acid is mildly increased. This is due to irritation of the growth or its toxins, and is significant only when it is on the increase to a certain point and then takes on a steady fall downward after that. In some cases of cancer, and in *ulcus carcinomatousum*, it may be present to the very end. Then, again, non-benign stomachs (normal and pathological) vary much in their hydrochloric acid content, and this secretion is influenced by so many conditions that its mere presence or absence at one time is of no value in this connection. The practical point in the diagnosis is its known steady progress, either

upward and then downward, or just downward (as the lateness of the case may be). Its upward rise is much more rapid and shorter in duration than its subsequent fall. When it begins to decline, it starts to do so slowly, accumulating as it comes downward, and runs an average fall of about four degrees in a week. In a suspicious case giving this excursion or downfall of total hydrochloric acid, be on your guard lest a tumor be palpable in the epigastrium a month or two afterward. On the gastric enzyme so much reliance cannot be placed. The tests for its quantity are not so accurate as those for the acid, and they are liable to vary more than the HCl. As the hydrochloric acid decreases, the organic acids begin to appear. Tests for their early presence should be made, as well as for other evidences of fermentation and delayed motility. There is liable to be retardation in motility before actual dynamic obstruction exists. In other cases little delay is observed, although fermentation is liable to be increased above that of normal.

The Solomon test (or Goodman's modification) for gastric carcinoma is sometimes positive early. Its absence is not significant in the negative, since it may not be present even late and may be present in non-cancerous diseases. But it is a measure with the others which may be helpful. The method consists of washing out the stomach in the evening and on the following morning introducing 400 cubic centimeters of normal salt solution. This solution is removed after a short stay in the stomach, and tested for the presence of albumin and for the proportion of nitrogen. Marked turbidity with Esbach's reagent (picric acid) or the presence of more than 30 milligrams of nitrogen suggests the presence of carcinoma. The glycyl-tryptophan may be applied to the filtrates of test-meals when the hydrochloric acid content is seen to be low and lactic acid is present and the reaction of the Oppenheimer test observed. These should also be made use of in all cases of stomach disorder that do not respond to medical treatment, whatever the diagnosis, and particularly when the general health is failing.

Upon the history of heredity and subjective stomach symptoms little can be depended upon to assist us in the diagnosis. "Family cancer," even more so than "family tuberculosis," is only of historical significance. Subjective symptoms, one and all, are of no value in the making of early diagnosis. As many if not more cases begin and progress markedly without as with them. When they are present, the other benign and simple stomach conditions usually have more of them or the same in a more intense form. Marked anorexia, eructations, aversion to meats, pain, pressure, distress, vomiting, hematemesis, tumor, etc., are all late symptoms. Of some value, however, is loss of weight. This begins rather early in a slow manner, but is rapid later. To record this best it is

advisable for the patient to weigh stripped each morning as soon as the rectum have been emptied and before he has taken a single drink. Careful observations and record should be kept of the weight. A loss of a pound or more in a week is inconclusive when the laboratory picture continues entirely negative. But when you are making these observations ~~say nothing about dieting~~, excepting that the patient should continue eating and drinking as before. If you curtail normal persons' diet they are liable to lose weight; and if you enlarge it, or suggest a total or ~~and~~ ~~a~~ ~~solid~~ diet—a common practice in treating ~~digestive disorders~~—you may gain even in the face of a cancer present in the stomach. ~~above all~~, be watchful for the patients who have ~~dieted themselves thin~~ when they have come to you.

To tell patients in a soft, guarded way that they have a tuberculosis which can be cured usually insures their hearty ~~compliance~~ to bring this result about. Likewise in a suspicious case it is well to inform them that a serious stomach disorder is ~~impossible~~ (you ~~not~~ mention cancer) and that it is impossible to find out ~~it is there~~ unless they carry out your orders and report regularly for ~~observation~~ and examination usually awakens their attention and the fulfillment of your desires. Office visits are better in these ~~observations~~ than placing the patient in a hospital.

In patients who present themselves for treatment of ~~gastro~~ troubles, view with suspicion every case over forty years of age ~~in~~ which does not show improvement after a course of treatment, whatever the diagnosis may be. Penzoldt rightfully advises that in these cases the diagnosis of cancer must either be made or refuted. At those ages also, be on your guard with every case that gives a history of a "good stomach" before the present illness. In the diagnosis of early cancer laxity in thoroughness and expectant measures may be handmaids of disaster leading you to a disagreeable surprise. It should never be forgotten that it is the usual thing that when a tumor manifests its presence, the case is past redemption in a curative way. In favorable cases it takes from two to four weeks of steady observation to make a diagnosis or present sufficient evidence of early malignant disease of the stomach. In these, the careful examination of six or more test-meals is usually necessary, several fecal and blood examinations, and the most detailed work with the X-rays. It is truly unfortunate that more medical men do not send their patients early enough to the radiographer for study of the peristaltic waves of the stomach. For if they did, the radiographers would become more expert than they are to-day in stomach and intestinal work for diagnosis of early malignant conditions, and more

lives would be saved. I have a number of plates which show jump-gaps in the peristaltic waves and localized thickenings in the pyloric region, and some of these cases have been operated upon in time and are alive and well to-day years after the X-ray observations were made. Then, with a reasonable certainty that cancer of the stomach exists, the case should be turned over to a surgeon for exploratory incision, and, if the diagnosis has been confirmed, total extirpation of the diseased area, adhesions, glands, and metastases be performed. It may incidentally be remarked that, unless the abdomen is very fat, exploratory incision may in some cases be satisfactorily performed under one-tenth of 1-per-cent. solution of cocaine. Under this, when the peritoneal cavity is entered, some care should be exercised not to impinge roughly on the parietal peritoneum (it is sensitive), nor should there be any tugging on the mesenteries when examining the stomach or intestines (patients are liable to vomit). In many instances with a little extra care and patience the examination can be made most satisfactorily under this local anesthesia, the posterior wall of the stomach can be explored, and if needs be the entire hand put into the peritoneal cavity so as to reach some distance beyond the abdominal incision. Patients will submit to an exploratory incision under cocaine, and be persistent against operation when a general anesthetic is intended to be used, although the latter is best. Usually, about an ounce of the cocaine solution is employed at these times, representing only one-half a grain of cocaine, a safe quantity for an adult. Ether or chloroform can be substituted quickly when surgical procedure on the gastroenteron is indicated.

Among the additional points that a few of the cases show from a clinical standpoint are, a persistent intercostal neuralgia with a failing health, and an enlargement of the gland of Virchow. Both of these may be rare symptoms. In the first, usually the lower intercostals on the left side are affected; and in the second, the gland mentioned is the small lymphatic node just behind the clavicular insertion of the left sternomastoid, which ordinarily, because of its small size, cannot be palpated, and which should be felt for in every suspected case of thoracic or abdominal neoplasm.

There is no always or never in medicine. This is well exemplified in the early diagnosis of this disease. The surgeon has a right to believe that many of these cases can be diagnosed earlier than he usually sees them. But he must also remember that a few cannot. And the internist likewise must be respectful of his full duty to these patients, and not fail to gain or lose sight of the valuable moment in which substantial help might have been offered.

**Diagnosis of Atypical Forms of Cancer.**—The atypical forms of cancer may be said to be those which manifest themselves in early or very late life, those which run a very rapid course, and those which give a subacute history over a more prolonged duration of time than is generally seen in cancer.

As to age, it has already been mentioned that cancer may occur in early age. Mathieu<sup>5</sup> collected 32 cases occurring in young persons. Because of the greater prevalence of sarcoma in early years these patients are liable to be regarded as suffering from that disease, particularly because, in the young, cancer cachexia may be absent or occur only very late. Cancer in the very old is a still rarer affection, and one even less liable to be diagnosed than those in early life. They are usually of the infiltrating type, diffusing themselves in all directions and tissues so that at autopsy it is quite difficult to tell whether the growth was originally gastric or not. These growths are often quite calcareous.

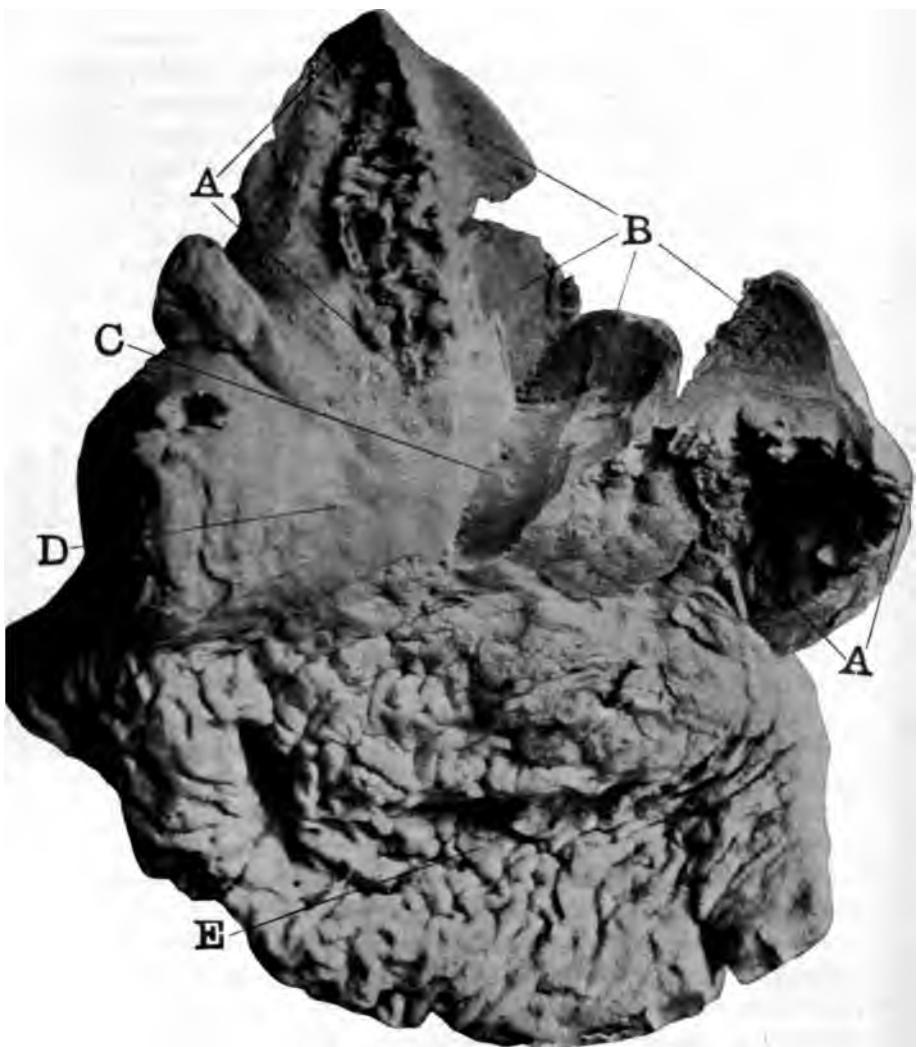
Cancer again may present itself in a markedly malignant form, carrying a case to a fatal termination in from one to four months. These cases are very rare, and present the picture of an acute illness of a mysterious nature. Even should a tumor become palpable, it is impossible to differentiate these cases clinically from those of a rapid form of sarcoma.

The cancers which give a latent history are usually the forms of encapsulated growths, or a very low form of malignancy of the ~~slim~~ rhous type. They are not so uncommon as was formerly supposed. These types are always suggestive of the long presence of a profusely organized chronic ulcer, which, in the course of time, undergoes malignant degeneration. They are the types of cancer which under higher feeding are liable to show favorable progress, and because of this may be very confusing. One of my patients of this kind gained 35 pounds in four months under a generous milk and egg diet, only at the end of an acute exacerbation to lose it before death.

#### ULCUS CARCINOMATOSUM.

Atypical cell proliferation may take place upon the basis of a benign ulcer causing the development of cancer. As far as we can judge clinically at operation and at autopsy, the development of most of the cases of ordinary gastric cancer begins as a primary affection. According to Boas,<sup>6</sup> the development of malignant degeneration on an ulcer is not a very frequent occurrence. On the other hand, Mayo, Rodman, Mumford and Stone, and others, declare this to be commonly the fact.

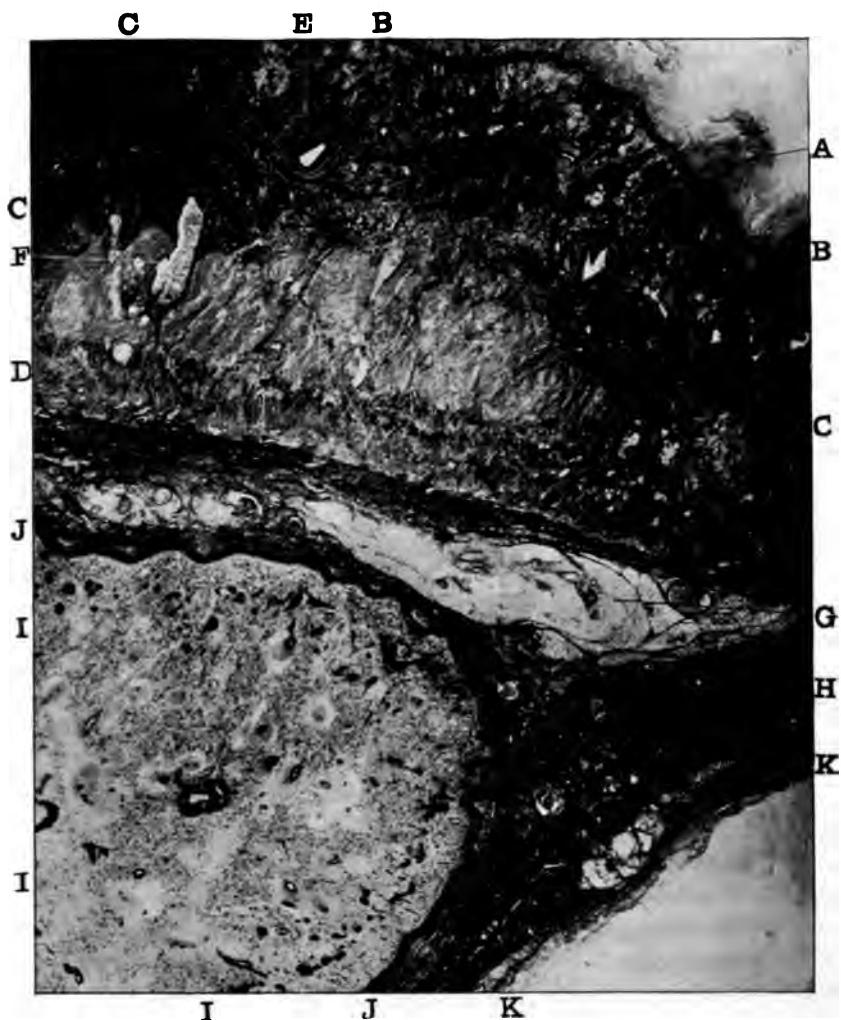
PLATE LXXVII.



*Ulcus carcinomatosum.* *A, A*, denote the edges of the chronic ulcer. *B*, The carcinoma mass beyond it. *C*, Deep cut through the specimen showing a marked formation of connective tissue between the ulcer and the carcinoma proper. The smooth appearance of the mucosa at *D* is due to the thickened connective tissue. *E* shows the mucosa of a chronic gastritis. Entire organ moderately enlarged.



PLATE LXXVIII.



Photomicrograph of an *ulcus carcinomatousum* situated at the lesser curvature of the stomach. *A*, Detritus covering the floor of the ulcer. *B*, *B*, Fibrous tissue which had taken the place of the gastric tubules, the latter entirely destroyed. *C*, *C*, Thickened submucosa composed of connective tissue with carcinoma cells grouped here and there. *D*, Muscularis mucosa. *E*, Artery. *F*, Vein. *G*, Muscular layer. *H*, Connective tissue, much thickened. *I*, *I*, *I*, Large carcinoma nodule. *J*, *J*, Capsule around same. *K*, Peritoneum. Stained with van Gieson (Hansen).  $\times 13\frac{1}{2}$  diameters.



To this latter view I stringently adhere, and wish to add that any continuous ulcer (chronic), an unhealed ulcer of the acute type, and protruding cicatrix (particularly one of some width) persisting through middle life, may, at any time, become cancerous. I am not of the belief, entertained by some surgeons, that 90 per cent. of all carcinomata have their starting point in ulcer. It occurs to me, based upon the history, examination, operative and autopsy findings of the cases which I have observed, that many more than 10 per cent. develop in those who were perfectly well before, who have never had any dyspeptic symptoms, or who have had pathological states other than ulcer as forerunners. Among these I would mention long-standing states of hypersecretion, continued irritability of the gastric mucosa from whatever cause, and states of chronic gastritis that have long been abused. Of course, one can never be sure in these cancer cases that an ulcer does not or may not have existed. We have only the clinical aspect of ulcer to guide us, and this, as is well known in many ulcer cases, is far from suggestive. Autopsies in persons dead of other than gastric affections have often caused surprise by revealing the presence of an unknown ulcer healed in the stomach with almost the same degree of regularity as fibrous and calcareous masses in the lungs from a similarly unknown tuberculosis. With these facts in mind, the point between von Mikulicz's statement that 7 per cent. of cancers follow old ulcer, and W. J. Mayo's that "a very large proportion of the cases which we have had gave an early history of ulcer of the stomach," the matter is plainly in favor of the latter author being nearer to the fact, particularly as cancer is most frequently found beginning in the ulcer-bearing area. In favor again of carcinoma being a primary affection are the statistics of Robson and Moynihan, showing that, on the posterior surface, ulcers were found in 25 per cent., while in cancer they were present in but 4 per cent. of the cases. Fütterer has pointed out that ulcers which become carcinomatous begin in localized areas, usually in those which are subjected to the greatest degree of mechanical irritation.

The "fishhook" appearance of carcinomatous ulcer (Hemmeter and Ames<sup>7</sup>), in my experience, has not been so common as that of a cup-shaped depression in the mucosa more or less filled in with a shaggy formation of connective tissue, in which the carcinomatous infiltration is uniformly general above and around it. Abundant connective-tissue growth causing a thickened mass is often observed, so that in viewing the cancer from the mucous side no typical cancer formation is noted, while in the depths and from the peritoneal side the picture is quite different. A rather soft form of ulcer may be seen which looks innocent

enough to the naked eye, but which when viewed through the microscope displays carcinoma cells about its edges.

The diagnosis is made from a history of the presence of chronic ulcer and the progressive cachexia and tumor in a stomach which persists in its secretion of hydrochloric acid. Moderately delayed exit and increased fermentation of foods are usually present and gas results from test-meals may be positive. Hematemesis or melena would aid in the diagnosis. The bleeding, however, may be intermittent and profuse enough to suggest a simple ulcer, and may be absent altogether. Sometimes, although hydrochloric acid be present, lactic acid in increased amounts will be found in the stomach. This is due to motor insufficiency, the mechanical obstruction of the mass at the pylorus, contraction of an overlying old ulcer scar, or from extragastric adhesions or metastases. When a definite tumor is absent, the diagnosis may be difficult, although the continuous symptoms occupying the middle ground between acute ulcer and cancer are strongly suspicious. A number of cases cannot be diagnosed as other than chronic ulcer or hypertrophic stenosis, but, as surgical therapy is indicated in both of these affections, resort to this before definite symptoms have appeared is advisable in both the diagnosis and treatment.

With the knowledge that at operation any form of chronic ulcer, no matter how innocent it may look to the naked eye, may be malignant or become so later, all of these should be excised. If more cases of chronic ulcer were operated upon in time, fewer cases of chronic stomach disorder would exist, and more cases of gastric carcinoma saved.

#### TREATMENT OF CANCER.

**Surgical.**—Most cases of stomach cancer terminate fatally in about one year after the onset of symptoms, although some may live considerably beyond this. In its early stages, before there has been much involvement of tissue, it is distinctly a surgical affection, fairly possible of cure. When the tumor is definitely palpable from without, and the symptoms moderately advanced, the value of surgery becomes much in doubt, and when the classical subjective and objective picture of malignant disease is established, the only possibility of surgery is in the relief of symptoms by establishing better drainage of the stomach or the removal of the major part of the malignant growth, or both, and these are but rarely possible in any safe way. It may be said as a practical fact—founded on the great majority of instances—that when a carcinomatous tumor of the stomach is plainly palpable through the abdominal walls, or when, whether this is evident or not, the chemicobacteriodynamic syndrome of the stomach is character-

istic of advanced disease, operation should not be advised. This is so because, when these abdomens are opened, more actual involvement of tissue is present than was supposed (making its removal almost a fatality); the presence of before unrecognizable metastasis in tissues impossible of safe removal; the very weakened condition of the patient for operation, and the poor results as regards union of tissues that have been primarily or secondarily affected by the disease.

By the modern awakening of interest in gastro-intestinal subjects, and in the earlier recognition and better selection of cases for surgery, and the improvements in the line of surgical technique in abdominal work, much better results than formerly are being brought about. A further continuance and advance in these will no doubt bring down the rate of mortality in resections to a much lower level as time passes. In fact, to-day, some surgeons and also institutions where close attention is given to these cases and all gastro-intestinal conditions are studied more closely from an internist's standpoint before surgical operations are performed are showing results which are highly gratifying. Patients must be made to understand that operation for cancer is a primary rather than an ultimate matter. When in a case in which the possibilities of surgery offer hope—either in diagnosis or removal—the matter should be presented frankly to the patient, and the responsibility of delay put upon him.

The operations of the radical kind are the pylorectomies, partial and complete gastrectomies and excision of the tumor. These, with the anastomosis operations, are described elsewhere.

Of 307 resections of the stomach upon known carcinoma, Mayo reports 150 of the patients operated upon more than three years before; 20 died from the results of the operation, and 40 could not be traced. This gives 90 patients who recovered from the operation and whose present condition they were able to trace. Of this number, 33 (36.6 per cent.) were alive. Of the 93 patients operated upon more than five years before, 15 died and 20 had not been heard from as to their present condition. Of the remaining 58, 13 (22 per cent.) are known to be alive and well over five years. These data indicate that a patient with a cancer of the stomach which is sufficiently localized to be removed radically has better than a 90 per cent. chance to recover from an operation and better than a 36 per cent. chance of a three-year cure, and at least a 25 per cent. chance of a five-year cure.

A matter of practical interest to the internist is the effect on the stomach of pylorectomy or partial gastrectomy. It has been proven that the removal of the pylorus improves the motor activity of the stomach and favors the emptying of the organ. The secretory activity

is not altered in the majority of the cases, and in some the secretion of hydrochloric acid is benefited. With better drainage, of course, stagnation ceases to be so much of a feature, and the lactic acid and bacterial content falls.

Among the palliative operations are included gastrostomy (for stenotic and malignant affections of the cardia and esophagus), and the various forms of gastro-enterostomies, which, in pyloric stenosis, are all drainage operations permitting of more direct exit of chyme into the intestines. As a class, these are operations of value. The first (gastrostomy) permits of direct feeding into the stomach, in those who cannot deliver food into the stomach by way of the esophagus in the natural way, by establishing a patent canal, and the second, the conversion of the stomach into a canal so that foods can be digested in the intestines. All are measures of value in the prolongation of life, and often in the relief of the symptoms.

In all cases in which the diagnosis of late carcinoma has been made there are two matters always to be kept in mind. First, it may not be cancer, but the growth be due to internal syphilis (hence the specific treatment should be tried for a while), and, second, even when unmistakable and inoperable cancer is noted at operation, a portion of the growth should be secured and examined to note if the neoplasm is epithelial or endothelial in nature (cases of the latter may often be cured or markedly improved by the assiduous employment of the X-rays).

**Medical Treatment.**—The medical care of these cases resolves itself into the following parts: Measures to better the state of gastric secretion and motility; measures to better the local symptoms and general state of body; anodyne measures to relieve pain and distress.

In considering the above in a general manner it must be said that much can be done in the way of relief to help these unfortunate cases. Two measures, particularly, stand out from the rest as of the most value, namely, regular lavage of the stomach and the use of morphine. Added to these are a suitable diet, and the use of medicinal agents to control the symptoms.

Whenever stagnation of food exists, where the hydrochloric acid is absent or very low and organic acids are present, for profound anorexia even when nausea and vomiting are features, regular lavage mornings and possibly also evenings is a means of benefit almost to the end of the case. In addition to its being the best therapeutic measure for the anorexia, eructations, and collective vomiting, it acts in a remedial manner in clearing out the fetid contents by removing the products of fermentation and putrefaction. Together with the toxic products from

the cancer itself that collect in the stomach, it removes decomposing foods, the products of which have a damaging effect upon the stomach, intensifying the subjective symptoms. Lavage also lessens the degree of the poisonous effects of these toxins on the system (anemia, cachexia, etc.).

The cleansing of the stomach is best done by the Leube-Rosenthal method of lavage, but may be successfully performed with the single tube and funnel apparatus. The lavaging should be continued until the water returns clear, whereupon the stomach may be considered as clean. While the method itself with simple saline or borate solution is the best tonic for these cases that can be employed, the following may advantageously be made use of when stagnation and fermentation are pronounced: Resorcin, 10 to 30:1000; salicylic acid, 3:1000; thymol, 5:1000, and hydrochloric acid, 5:1000. A good plan is to employ the simple solution for cleaning the stomach, and then finishing the lavage with one of the disinfecting solutions, of which the hydrochloric acid is of the best service in the majority of cases. Occasionally, in late cases, lavage is too severe a procedure and is liable to bring on a collapse. In these instances rectal feeding may be resorted to for a while to do away with the collection and decomposition of foods in the stomach. But it must be said that rectal feedings in these cases are virtually never productive of any benefit, and may do actual harm.

In the use of opium (morphine, codeine) it may be said that there should be no objection when the diagnosis is sure and the pain and general distress severe enough to warrant it. Cancer is a fatal disease of short duration, and it makes no difference whether the habit be contracted or not. In fact, it is a Godsend to many late cases should this be so, for, then, all symptoms and the constant general distress are much relieved. It should never be employed by mouth, because the drug is only minutely absorbed from these stomachs and vomiting may be increased. The hypodermic method, or, less favorably, the rectal administration, is to be preferred. For the pain cocaine hydrochloride may be employed, either in the form of solution run down through the tube after the lavage, or by mixture. In stagnant stomachs the single instillation of a 0.03 to 0.06 gram ( $\frac{1}{2}$  to 1 grain) dose mornings often acts as an efficient local anodyne and sedative. I have observed that its action is much prolonged beyond what one would expect from cocaine (this is probably due to the solution remaining in the stomach for a long time). A recipe of value for continued use is the following:—

B Cocainæ hydrochloridi ..... 0.7 gr. xj  
 Tinctura valerianæ ..... 60.0 ʒij  
 Aqua chloroformi ..... q. s. ad 120.0 ʒiv

M. Sig.: Take one teaspoonful in water every four hours through a tube.

Codeine and belladonna by mouth may relieve the pain and distress by controlling local secretion in the stomach, a matter in stenosis with dilatation that is always a prominent feature. External applications of heat or cold have a moderate effect not much to be depended upon.

For a favorable general effect upon a cancerous stomach condurango was at one time lauded as a specific. Extensive use has blasted its employment until to-day it is looked upon with derision. It is, however, the best stomachic tonic we have in these cases, and if an appetite can be aroused or digestion improved at all it answers best of any medication. A formula of service is:—

B Fluidextracti condurango ..... 90.0 ʒij  
 Tincturæ nucis vomicæ ..... 15.0 ʒiv  
 Acidi hydrochlorici diluti ..... 20.0 ʒv  
 Elixir gentianæ ..... q. s. ad 180.0 ʒvj

M. Sig.: Take two teaspoonfuls in a wineglass of water, after meals, through a tube.

When the anemia is pronounced, the hematinic tonics may be of value. Among these I would suggest the preparations of the National Formulary: Elixir gentian and tinct. iron chloride, and liquor iron and manganese peptonate. To these, strychnine sulphate may be added. For the vomiting of reflex or general toxic nature, as well as for the sleeplessness, the bromides in full doses are of benefit; these may be used per rectum as well as by mouth. The constipation is best relieved by rectal enemata; and the diarrhea by bismuth salicylate, benzonaphthol, columbo, opium, and the time-honored pilula plumbi et opii is also of value.

Of first importance in the medical care of these cases is proper dieting. The nature and character of this depends entirely upon the chemico-dynamic state of the stomach. Naturally, one would desire to feed these patients so that their distress would not be intensified and at the same time keep close to their power and capacity of utilizing food. When pyloric stenosis of a marked degree exists, only the fluid form of nutriments should be used. Among these may be mentioned the fermented milks, cream, vegetable purée, soups, eggs (raw or soft boiled), cocoa butter, the peptone preparations of food, milk powders, tea, coffee, ale, etc. If prostration be present, cognac (diluted) or iced champagne in small doses may be added. When the stomach is very irritable only fluid foods should be employed in small quantities and at intervals of one hour.

When pyloric stenosis is not so much of a feature in a case, the feeding should be liberal in selection and generous in amount, employing the food in smaller quantities at a time and in three- or four-hour intervals. The more food per day the patient can take and assimilate, the better the general state of health, strength, and fortitude against distress. These patients should be permitted to partake of whatever foods they may care for, preference, of course, being governed by their nutritive value. When hydrochloric acid is entirely absent from the stomach, it is sometimes advisable to control the amount of animal proteins ingested and meet the shortage with the farinaceous vegetables and fats.

On the basis that carcinoma is not met with as frequently in the East (Japan, Corea, the Philippines, etc.) Bulkley<sup>8</sup> suggests that it may be due to meats, coffee or alcohol and advises their elimination from the diet.

The therapeutic employment of the X-rays and radium in the treatment of these cases in the non-operated to relieve the pain and cause a retardation of the growth has been suggested, and in the post-operative ones to prevent its return. Regarding the first, I have had some experience and believe it to be useless, and, in fact, I think that certain chemical changes are liable to be brought about in the neoplasm, with an increase of the toxemia. Following operations of removal, naturally one could never be sure if the X-rays or radium accomplished anything worth while or not. Roswell Park, however, has recently stated: "I have convinced myself that they (X-rays) are of great value after operations where portions of the abdominal viscera or of abdominal growths have been removed on account of cancer. Here they seem, at least, to retard recurrence, and I repeat, in my own experience, to apparently prevent it."

When a plant or animal body is exposed to the action of roentgen or radium rays, there probably takes place the same atomic disturbance in the cells of the body as in a piece of metal or other unorganized substance, and as a consequence the rays injure the protoplasm, or more frequently the nuclei of the cells. This biological action differs quantitatively in accordance with the amount and character of the rays absorbed by the cells and the specific susceptibility of the latter to the action of the rays. When slightly injured the cell may recover completely, whereas if the injury is severe the cell dies.

All the tissue of the organism may be killed by a sufficiently large quantity of rays, nevertheless the biological action of the roentgen rays must be considered selective, inasmuch as quantities of the rays sufficient to kill a certain kind of tissue may leave adjacent tissues intact or only slightly injured.

In order to obtain this selective action, the rays must be distributed as evenly as possible through the organism, so that only a comparatively small quantity of the rays will reach each individual cell. On the other hand, a sufficiently large fraction of the rays must reach as far as possible from the surface of the body. Such distribution is only possible with hard rays, of which the penetration is much greater than the absorption.

The cells of malignant tumors are more susceptible to the action of the rays than the normal tissue cells surrounding the tumor. If the rays employed are of a correct quality and in a sufficient quantity, it is possible to destroy all the cancer cells in a certain locality, and at the same time leave the normal tissues either intact or so slightly injured that they ultimately recover completely.

The action of the rays on a malignant growth consists primarily in the destruction of the tumor cells, and subsequently the formation of sclerotic connective tissue which compresses and destroys the remaining tumor cells. In order to get a better estimate of the results obtained by this method of treatment, the writer made a statistical analysis of cases treated by himself and others. Of the very extensive literature on this subject, only those reports were selected in which the whole number of cases treated in a certain clinic were given, and not only selected favorable cases.

Considerable investigation has recently been carried on in the study of the internal secretions on the immunity against and the treatment of cancer. Rohdenburg, Bullock, and Johnston, as a result of work conducted along the lines of Gwyer, the pioneer in this field, have arrived at the following conclusions: "1. Removal of certain glands (*i.e.*, thyroid thymus, and testes) appears to decrease the susceptibility to cancer. 2 Removal of single glands or combination of glands in immune animals leads to lessened immunity to cancer. 3. Extracts of thymus, thyroid, spleen, pancreas, pituitary, and testes on injection tend to increase immunity against cancer, and extracts of certain other tissues produce like effects. 4. Similar extracts, on injection in cancerous organisms, alleviate pain, reduce tumors, or even cause them to disappear. 5. Our results, combined with those of other observers, tend to the conclusion that many tissues contain some common element, possibly of the nature of a hormone, which is capable of producing immunity."

I have had some cases treated by means of hypodermic administration of thymus extract, and some improved noticeably for a few months. Their pains were less, the tumors decreased in size, they gained somewhat in strength and in quality of blood, and seemed to live somewhat

longer than if they had not been so treated. The treatment is not curative, but only palliative.

The only treatment that offers possibility of cure is a diagnosis early in the disease and then radical surgery for its entire removal. By this happy combination I have now thirty-seven cases of gastric carcinoma that are well after four years.

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## CHAPTER XXII.

### Malignant Diseases of the Stomach.

(Continued.)

#### GASTRIC SARCOMATA.

##### ETIOLOGY.

A SARCOMA is a connective-tissue growth whose cell elements, either because of their number or size, predominate over the inter-cellular substance. In this way they differ pathologically from carcinomata, which originate in the epithelia, although in the soft forms of cancer the distinction is not marked.

Being a less common form of malignant growth than cancer, sarcoma has not excited the degree of interest in the pathology of the stomach that cancer has. There is no doubt, however, that future years and more general use of the microscope will show sarcoma of the stomach to be more frequent than it was formerly thought to be. My reason for this belief is that, in the past, too much dependence has been placed upon the gross appearance of growths, which is extremely unreliable in differentiating between ordinary carcinoma and some varieties of sarcoma and endothelioma.

Sir C. Perry and Dr. L. Shaw, out of 50 cases of primary malignant disease of the stomach, found that the growth was sarcomatous in 4 (8 per cent.). Fenwick reports from 5 to 8 per cent.; Yates, 2 per cent. in 800 cases of stomach tumors; Ewing, 1 per cent.; Smithies and Ochsner about 4 per cent.

Unlike carcinoma, sarcoma is commonly a disease of young adults or even of the child, although certain forms of sarcoma seem to be more common in the old. Of the 121 cases of sarcoma of the stomach which Lofaro collected the age of the patients varied between 3 and 78, though more cases occurred between the ages of 40 and 50 than in any other like period. We know no more about its origin than carcinoma, excepting that cases have been met with in which local trauma has definitely occurred. Notable among such is a case reported by Brooks,<sup>1</sup> in which a diffuse sarcomatous deposit occurred in the scar of an old stomach wound which was inflicted by a gunshot injury received over thirty years before and part of the course of which was noted in the superior surface of the left lobe of the liver corresponding to the wound of entrance and the location of the sarcomatous deposit (autopsy). Sex

does not show any particular difference as to the frequency of its occurrence. A parasitic origin has not been demonstrated. Cohnheim's theory pertaining to the origin of cancer seems to have a greater significance in sarcoma for the reason that the latter growths are so closely related to undeveloped connective tissue that sarcomatous tissue may be compared to embryonal tissue. In 2 per cent. of all sarcoma cases, the growth is primary in the stomach.

#### PATHOLOGY.

Sarcomata are connective-tissue tumors developing either in inherent connective tissue or in deposits of connective tissue such as are found in the benign growths. The transformation of the connec-

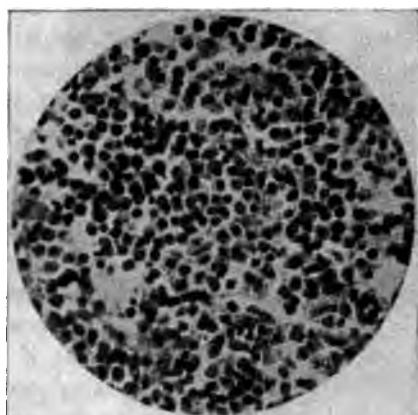


Fig. 129.—Sarcoma of stomach. Section through tumor. (*Douglas.*)

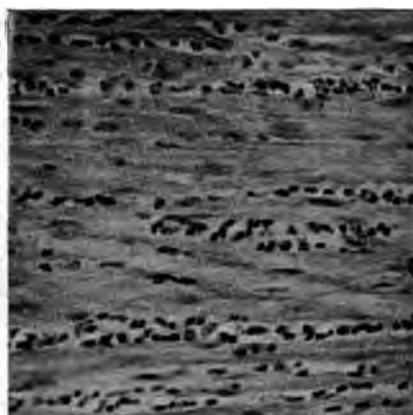


Fig. 130.—Sarcoma of stomach, showing infiltration of stomach walls with tumor cells. (*Douglas.*)

tive tissue into tumor takes place through growth and multiplication of the existing cells by mitosis, which, in rapid growths, are the more abundant element in its makeup.

The sarcomata of the stomach may develop primarily or secondarily. The primary forms are seen as circumscribed, nodular tumors usually located at the greater curvature. This so-called medullary variety is very soft and cellular, poor in intercellular substance, is more common in the liver and intestines than the stomach and in the stomach usually presents a hemorrhagic surface and on section a marrow-like white or grayish-white surface. The harder forms are more dense and white on cut surface, poor in cells and rich in fibrous intercellular substance, and pass by insensible gradations into fibromata (fibrosarcoma). They arise either in the muscular or submucous

layer, while the glandularis above remains intact or may ulcerate for the same reasons as in cancer, *i.e.*, usually from necrosis brought on by strangulation of the circulation. The forms that have been noted by Salaman are the lymphosarcoma, round-celled sarcoma, polypoid fibro- and myxo-sarcomas of the stomach, and sarcoma of the peritoneal glands directly invading the stomach; to these, to cover the varieties of growths as they are histologically seen, may be added myosarcoma, spindle-celled sarcoma and angiosarcoma.

A histological classification of these tumors is notoriously very difficult. In all forms, retrograde changes (fatty and mucous degeneration, caseation, necrosis, gangrene, liquefaction and ulceration) are quite common.

At autopsy in these cases the stomach displays many varieties of malignant formation. The growth may be flat and diffuse, showing thickening of the walls without definitely circumscribed tumor formation, and the stomach as a whole may be small and, except for the ulcerated areas, its mucosa free and anemic (myo-, myxo- and angiosarcoma). On the other hand, the stomach may be of enormous size, with large, rounded swellings plainly showing on both the glandularis and peritoneal surfaces of the organ. In large growths the glands lying around the celiac axis are usually involved and may be continuous with the walls of the stomach so as to make a thickened united mass. The inner surface of the stomach may be coated with a ragged, greenish layer of slough and slime, and under the microscope a patch of mucous membrane which presents no visible abnormalities may show a marked round-celled infiltration. In such large-sized primary growths the inner coat is usually very atrophic and necrotic, which, according to Salaman,<sup>2</sup> is not due to any growths in it, but is part of the gangrenous gastritis seen everywhere. The pancreas may be adherent, and multiple raised ulcers may be seen in the intestine. Other cases are noted in which the transition from sarcomatous formation to the glandular layer is sharp and the parenchymatous cells of the latter, even the central, are normal. In the Kundrat type of lymphosarcoma enlarged glands are commonly met with everywhere, even extending to the kidneys and the ovaries. The polypoid fibro- and myo-sarcoma and round-celled sarcoma are more often free from extensive abdominal involvement, with perhaps no enlarged glands. The intestine may be adherent in places, small miliary deposits in the peritoneum (which resemble those of miliary tuberculosis) may be observed, the spleen may be enlarged, and chronic nephritis is common.

Sarcoma of the stomach may be divided into three distinct groups of cases: (1) Spindle-cell myosarcoma; (2) lymphosarcoma; (3) mis-

PLATE LXXIX.



Primary myosarcoma situated at the greater curvature of the stomach. The tumor grew inward into the cavity of the organ, but still caused a bulging of the peritoneum, evidencing its presence before the stomach was opened. The thick, dark line in the upper part of growth and the small cavity to the left of it represent where pieces had been taken out for microscopic examination. The entire organ itself was not much enlarged and the walls not much thickened. The glandulature showed marked cellular change (degeneration).



leous round-cell or lymphosarcoma, the nature of which is uncertain. It may be diffuse, involving the whole stomach, or form large masses polypoid. Cantwell removed one weighing 12 pounds. Barrington<sup>1</sup> reports a case in which the mass projected into the stomach cavity near the pylorus in such a manner as to obstruct the exit of the stomach. A considerable number of cases are reported as exogastric tumors. They have therefore been classified by Burgaud as exogastric, endogastric, infiltrating.

As the round-cell variety and lymphosarcoma originated in the submucous layer and the spindle cell in the muscular layer, ulceration does not occur as readily as in carcinoma, which originates in the epithelial layer. Lymphosarcoma and the round-cell variety are usually infiltrating, while the spindle cell or myosarcomata form discrete tumors which either be sessile or pedunculated and often grow to a large size. At the recent meeting of the New York Pathological Society Pagenstecher exhibited a specimen of myosarcoma which weighed 11 pounds. Cystic degeneration of these larger tumors not infrequently occurs.

Concerning the relative frequency with which the various forms of sarcoma occurred, Forni, in an analysis of 200 cases, in 190 of which the histology of the lesion was noted, found round-cell (including lymphosarcoma) in 98, spindle-cell in 39, polymorphous structure in 14, and special types such as angio or myosarcoma in 39. According to Hesse, perforation of the stomach occurs in 8 per cent. of the cases.

Round-cell and lymphosarcomata increase more slowly in size than spindle-cell, and, judging from the statistics of the progress of the disease, the rate of sarcoma of the stomach metastasizes less rapidly than carcinoma, and the length of life after the appearance of the disease in non-operative cases appears to be longer than in carcinoma cases. Therefore, operative treatment should afford a better prognosis than in carcinoma ventriculi.

It would appear that a benign tumor, as a leiomyoma, may exist for years, grow slowly, and then become sarcomatous. Kimpton reports such a case in a woman of thirty, in whom he resected the stomach for a round-cell sarcoma. The patient stated that she first noticed the tumor when she was eleven years old.

*Metastases.*—While forming less rapidly than in carcinoma, metastases, when they do occur, are most frequently found in the lymph-nodes, either in the region of the stomach, and secondly in the liver, as occurs in carcinoma.

*Location of the Lesion.*—An analysis of 146 cases in which the location of the lesion was given, published by Flebbe in 1913, showed it to be situated at the pylorus in 37; greater curvature, 30; posterior wall, 26; lesser curvature, 13; anterior wall, 8; cardia, 3; pylorus and both curvatures, 2; while in 27 cases almost the entire stomach was infiltrated.

In multiple sarcomata or extensive metastases from sarcoma primarily situated elsewhere than in the abdominal cavity, the general organs and the peritoneum may display numerous metastatic growths with others more or less discretely scattered throughout the walls of the stomach.

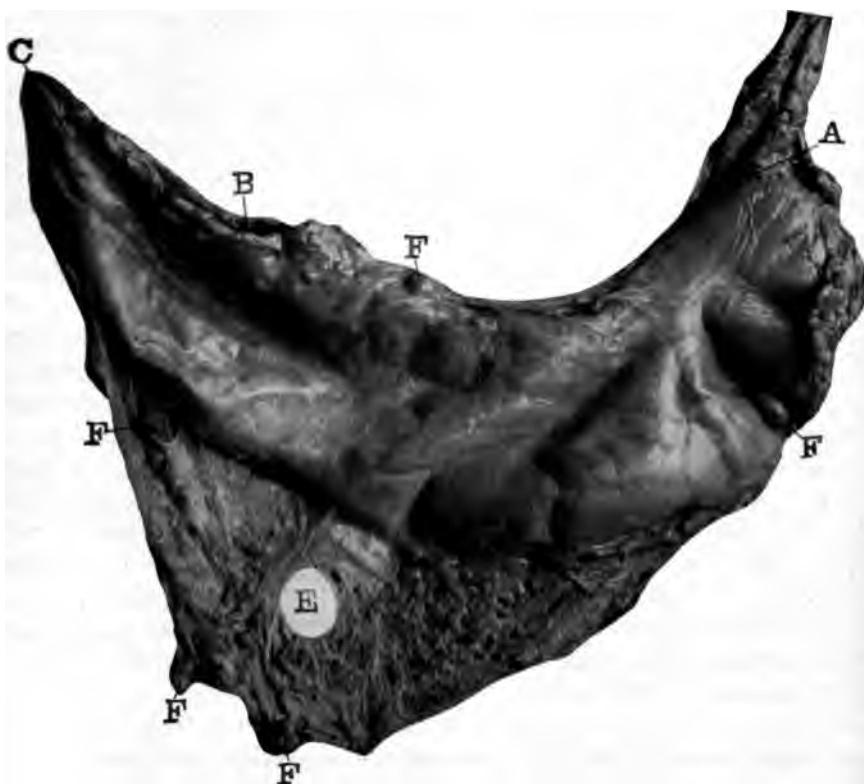
#### SYMPTOMS AND DIAGNOSIS.

In cases of secondary involvement of the abdominal organs where evident extensive metastases from a parent growth exist, the diagnosis can only be made by assumption, for, as a rule, no special abdominal symptoms are present. In the primary forms, much of the detail of symptomatology that is found under cancer also answers for sarcoma. In a close perusal of the clinical history of 29 cases that have been reported it is plain that vomiting of blood is a much more constant feature in cases of sarcoma than in carcinoma, and this appears earlier and greater in extent than in cancer and more like that due to acute ulcer.

The subjective symptoms resemble those of cancer, but the cases generally run a more rapid course from the beginning of symptoms to fatality, which varies from two weeks to six months. The more chronic and fibrous forms, however, simulate cancer in this respect. There is usually a history of a certain amount of prior digestive disturbance rather suddenly developing into vomiting, hematemesis, severe anorexia, weakness, and emaciation. Pains in the epigastrium are usually present, and these are liable to be more constant, as in ulcer, and not so nocturnal, as in cancer. In a case under my observation aversion to meat was at no time present. Cases are met with in which no gastric symptoms are present and the disease not suspected. Several of such have been reported in which no intimation of the presence of sarcoma of the stomach was disclosed until the autopsy was made. Pain is the most constant symptom in these cases.

As to the objective symptoms, there are two matters that are liable to be particularly misleading in diagnosis, and these are, that, because of the localized formation of the primary growth and the fact that the general glandularis usually is not involved, the secretion of HCl and the enzyme is liable to persist to the end (as in *ulcus carcinomatousum*), and obstruction at the pylorus (as in cancer) is not likely to be present. In the 121 cases Lofaro collected, only 8 had symptoms of pyloric stenosis. In lymphosarcoma there may be marked dilatation of the stomach without pyloric obstruction, in which, from the poor and failing general condition of the patient and the hematemesis, the differential diagnosis from it and primary atony, latent or chronic

PLATE LXXX.



Exterior of a stomach from a case of multiple sarcoma. Sarcoma metastases were also found in the heart, pericardium, lungs, liver, spleen, mesentery, pancreas, uterus, etc. Three small growths were found in the glandularis. *A*, Pylorus, duodenum above it. *B*, Cardia. *C*, Fundus. *E*, Greater omentum. *F, F, F, F, F*, Small sarcomata, found also in other places on the specimen.



ulcer, and cancer would have to be considered. Naturally, a dilated stomach which empties itself of food overnight argues against secondary atony, and bleeding which does not improve under the ulcer treatment must be considered as due to malignant disease or, better yet, a case for exploratory incision. The Boas-Oppler bacilli are not common, but have been reported in a few instances; they are much more regularly found in cancer. Blood in the test-meals is rather constant, and, as was mentioned above, is liable to be larger in amounts than in the early stages of carcinoma. If gastric analyses are not made, the examination of the feces for blood is, of course, most important and essential. Lactic acid may or may not be present, depending upon whether pyloric obstruction or thickening of the stomach wall interfering with proper motility exists. According to Fenwick, the sulphocyanide of potassium in the saliva gradually disappears about one month before death. The gastric contents should be searched for tumor particles, and in a suspected case a fragment from the tumor may be dislodged by lavaging the organ with the inflow delivered under considerable pressure. Persistent albuminuria is often observed in sarcoma, but is exceptional in cancer.

The patients usually display more or less emaciation with marked anemia and, late in the case, cachexia. Purpuric spots or blotches may be observed. On physical examination a tumor may or may not be palpable; this depends upon the formation and size of the growth, which, in one of Salaman's cases, weighed 14 pounds. When emaciation is marked enough so that palpation of the abdomen is an easy matter, a firm, globular mass in the epigastrium at about the midline may be recognized. Generally this is tender to pressure and accompanied by rigidity of the recti in that region. Inflation of the stomach and auscultatory percussion may show the tumor to be attached to the stomach. An early rise in temperature, 40° C. (104° F.), of a continuous character, with a pulse of 110 and respirations in the twenties, may exist; even late in cancer the rise in temperature is not so high or constant. The soft forms of sarcoma are more rapidly fatal than the medullary carcinomas, the average clinical course being about six months. With the mixed varieties of sarcomata the fatal result may be delayed as long as three years; as compared to the common hard form of cancer, this is about double the length of time.

Although a positive diagnosis of sarcoma could not be made by X-ray examination, the X-ray is the greatest aid we have for making the diagnosis of the presence of an operative lesion. Deformity of the stomach, filling defects, irregularity of the outline, interference with the peristaltic waves, the relation of the stomach to an exogastric tumor, and light areas

of any size in the body of the stomach all point to operative conditions, and the last mentioned finding is the more constant in solitary sarcoma of the stomach.

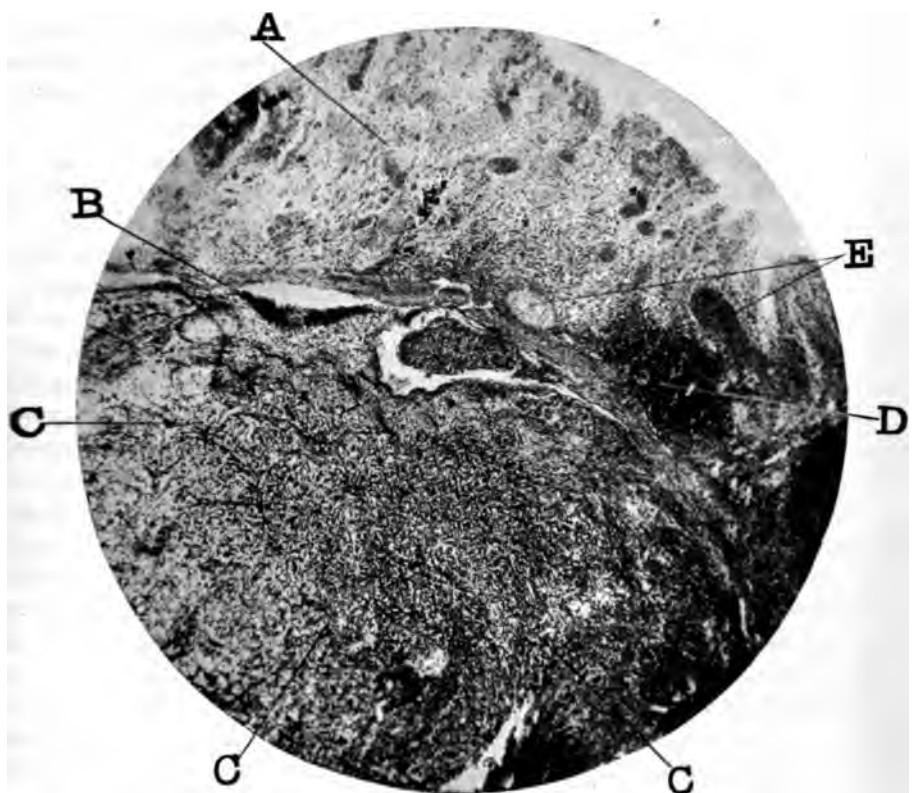
#### TREATMENT.

**Surgical.**—In every case in which the diagnosis of malignant disease of the stomach is suggested, surgery should be the first thought as the proper therapeutic course to advise. In sarcoma of the stomach, as in cancer, the desirability of this depends upon the general condition of the patient and the local findings on examination (for the reason that operations of extirpation are always serious matters and are useless in late cases). Cases have been reported in which the results from operation have been good, but for the reason that metastases and recurrence in sarcoma are so common one should not be too exultant or definite in the prognosis. At operation the tumor may be recognized as a purplish, nodular mass, hemispherical in shape, and situated at the lesser curvature. In such an instance a V-shaped resection from the anterior wall and a partial resection of the lesser curvature would be required. Obviously, the excised portion should include a free margin of normal appearing glandularis around the growth, because usually on the peritoneal surface the edge of the tumor passes by indistinguishable gradations into the normal mucosa and it would be necessary to remove the surrounding cell infiltration. In what appears to be a successful case, the post-operative prophylaxis against recurrence is most important, and this comprises particularly the use of Coley's mixed toxins and the therapeutic employment of the X-rays.

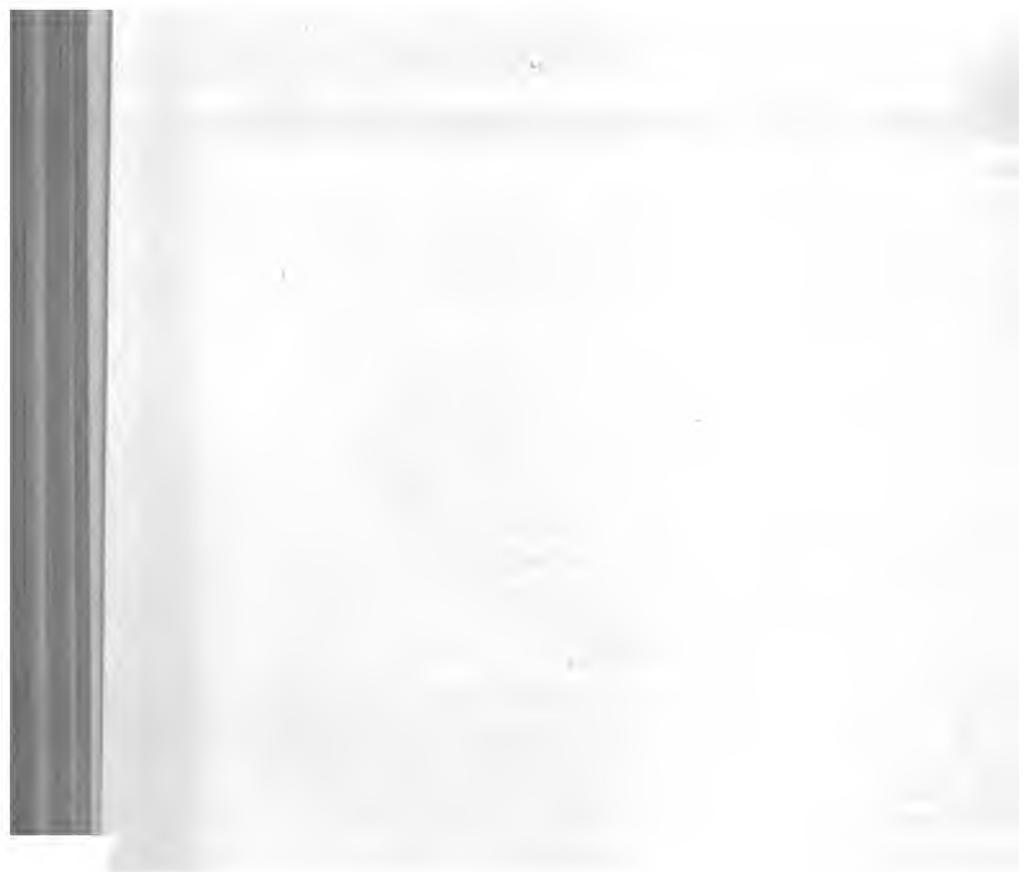
**Medical.**—As a prophylactic against recurrence and the treatment for inoperable cases there are two measures that have excited broad interest, namely Coley's mixed toxins and the X-rays. Remembering that a small proportion of carcinoma cases are really instances of sarcomata, these may be tried in all of the inoperable cases of malignant disease. In those which are cancer, however, no benefit is derived and even harm may be done. It is probable that Coley's mixed toxins would be found beneficial in more cases of sarcoma of the long bones than in the visceral affections.

Based upon the clinical fact that a considerable proportion of cases of inoperable cancer of all varieties and especially sarcoma have been known to disappear under attacks of accidental erysipelas and the patients have remained well thereafter, Coley<sup>3</sup> has suggested the use of the mixed toxins of erysipelas and bacillus prodigiosus in inoperable sarcoma. Other than from the successful treatment of 51 cases of inoperable sarcoma by Coley, in the great majority of which a careful

PLATE LXXXI.



Photomicrograph of one of the small sarcoma metastases from Plate LXXX, which was projecting into the cavity of the stomach (endothelioma). *A*, Gastric mucosa densely infiltrated with sarcoma cells. *B*, Connective tissue between same and the sarcoma mass. *C, C, C*, Bulky deposit of small and large sarcoma cells. *D*, Lymph nodule. *E*, Veins filled with blood-cells. Stained with van Gieson (Hansen).  $\times 54$  diameters.



microscopical examination had been made and were adjudged inoperable by leading surgeons, Tracy and Beebe have demonstrated that large multiple sarcomas in dogs rapidly disappeared under local or systemic injections with the mixed toxins. Coley believes that the following are the indications for the use of the mixed toxins: (1) in all cases of inoperable sarcoma, excepting the melanotic, which are probably of epithelial origin; (2) in cases of sarcoma originating in the long bones, in which operation means the sacrifice of a limb; (3) immediately after operation (within a week or two) in all primary inoperable cases as a prophylactic against recurrence; (4) in addition to the foregoing, after primary operations for carcinoma as a prophylactic against recurrence. The use of the toxins as a prophylactic after operation he believes offers by far the most important field of all, the proportion of recurrences in his own experience thus far being less than 25 per cent., whereas in cases in which the toxins were not used after operation the proportion of recurrences had been fully 75 per cent. As regards the dangers from the use of the toxins, he states that personally he has found their administration practically free from danger. However, he has learned of several fatal cases in the hands of other men, which, taken together, show that there are certain risks connected with the treatment. He believes that, if the precautions he had always made it a point to emphasize were observed, these risks would be reduced to a minimum. Most of the fatal cases that occurred were due to neglect of those precautions. For use after operation small-sized doses are advised, only sufficient to bring the temperature up to 99° or 100° F. (37.2° or 37.8° C.) three times a week, and continued for five or six weeks. According to Coley, in treating inoperable cases it is well to begin the systemic injections in every case with a very small dose, not over  $\frac{1}{4}$  minim, diluted with a little boiled water to insure accuracy of dosage. In a short time the quantity should be increased to  $\frac{1}{2}$  to  $\frac{3}{4}$  of a minim at a dose and kept up until the desired reaction is obtained, which corresponds to a reaction of 39° to 40.6° C. (102° to 105° F.). The frequency of the injections depends upon the strength of the patient, some being able to bear daily injections, while in others it may be unwise to push the treatment beyond three or four injections a week. In successful cases the effect is, as a rule, promptly noticeable; the tumor becomes smaller in size, much more movable and less vascular—these changes may appear within two or three days. If improvement does occur, the treatment should be kept up, either until the tumor has entirely disappeared or until it has become evident that the injections have lost their inhibitory influence. If precautions are observed, the injections can be kept up in moderate doses for long

periods without harm to the patient. If no improvement has occurred at the end of three or four weeks of daily injections the treatment is not likely to be successful.

It has been proven that sarcomas yield better to the X-rays than carcinoma. Numerous cases of sarcoma of the long bones are on record in which the Roentgen rays have caused a liquefaction of the tumor with recovery or assisted to this end by surgery at the end of a course of rayings. Pfahler<sup>4</sup> in an article on this subject drew attention to the desirability of raying as a post-operative measure following malignant disease and stated that it seemed we might hope for 50 per cent. of recoveries in sarcoma. In the series he reported 65 per cent. had recovered. In cancer of an advanced type good results are occasionally met with, but generally one can hope only for palliation or prolongation of life. The foregoing pertains particularly to cancer of the internal organs, and not to the superficial structures of the body.

Other than the above, the symptomatic treatment of sarcoma of the stomach is identical with that of cancer, and will be found described in detail in connection with that disease.

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- <sup>2</sup> SALAMAN: Trans. of the Path. Soc. of London, 1904, vol. iv.
- <sup>3</sup> COLEY: Annals of Surgery, September, 1891.
- <sup>4</sup> PFAHLER: American Journal of the Medical Sciences, April, 1909.

## CHAPTER XXIII.

### Benign Tumors of the Stomach.

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#### GENERAL CONSIDERATION.

THE stomach may be the seat of several kinds of tumors of the benign type. Taken collectively, these are very rare, the great majority of the palpable growths being carcinomatous in nature. Among the forms of benign growths that have been found may be mentioned adenoma and papilloma, myoma and fibromyoma, lipoma, myxoma, lymphadenoma, polypi, and retention cysts, to which may be added gastroliths and foreign bodies, the thickenings of the pylorus (hypertrophic stenosis), and diverticulum of the stomach.

#### PATHOLOGY.

**Adenomata and Papillomata.**—As a rule, the first of these are found as small, white, translucent, irregular growths composed of tubular structures, and the papillomata as wart-like or pedunculated growths of a firmer consistence. Adenomata may also occur in the intestines and may be found with a pronounced glandular structure, in which instance they closely simulate malignant formation, and thus have been termed malignant adenomata or adenocarcinomata. A number of types of gastric adenoma have been described. Three groups may be recognized: 1. Polypoid adenoma, either single or multiple (*les polyadénomes polypeux*). In this type, the interior of the stomach presents one or more polypoid growths springing from the mucosa. As many as 300 have been reported in one case. 2. The so-called polyadenoma *en nappe* of Menetrier. This is characterized by involvement of large areas of stomach wall, measuring perhaps as much as 10 or 12 centimeters in diameter. In this way large plaques are produced, rather than isolated polypoid out-growths. 3. The adenoma of the Brunner gland type, which was first described by Hayem in 1897. The point of distinction in this variety is that the gland tissue of the tumor, even though the latter be located in the stomach itself, is of the type of the Brunner glands which are found normally in the duodenum. This is the rarest of the three forms.

**Myomata and Fibromyomata.**—The myomata develop in the muscular layer and extend into the cavity of the organ. They are

often numerous and of small size, forming slight elevations of the mucous membrane, but may be single and of considerable size and perhaps pedunculated. Unless of some size they are very liable to be overlooked at autopsy. The fibromyomata are found somewhat larger than the myomata and may reach in size to a pigeon's egg. Like the myomata, they consist of unstriped muscular tissue with the addition of fibrous tissue. As a rule, the mucous membrane is intact and normal over these growths.

**Lipomata.**—Small-sized lipomata are occasionally seen in the submucous coat. Like the myomata and fibromyomata, they are generally seen small in size, forming projections which are covered with mucous membranes, but which thin out as the tumor increases in size. More rarely the tumor separates the muscular fibers, forming small hernias under the serosa. Orth has observed lipomata growing from the serosa in a pedunculous manner, and a large tumor of this kind may cause digestive disturbance by the dragging of its weight on the stomach.

**Angiomata.**—Made up of a network of capillaries, showing more or less dilation, with pigmentation, may affect the stomach. The diagnosis made (usually by X-ray) is that of malignant disease which on X-ray examination it cannot be differentiated from. The growth is generally small in size and most often in the fundus or body of the stomach. What is interesting here is that these cases usually have marked symptoms of epigastric distress (which may come on acutely), diarrhea, tarry stools, pain in the stomach and loss in weight.

**Myxomata.**—These growths consist of fragile connective tissue. They are seen as small, jelly-like deposits containing much mucus and are usually complex in make-up, such as myxolipoma, myxofibroma and myxoadenoma. On cut surface they are pale grayish or reddish white in color, and when microscopically examined generally display a thin capsule which extends by fine stellate prolongations into the growth. The myxomata grow from the connective tissue in the submucous or intermuscular tissue. Their growth is slow and they rarely attain considerable size in the stomach, although when mixed with sarcoma cells they may develop very rapidly. In other instances they are pedunculated (mucous polypi), may be as large as a hazelnut, and may be quite numerous in the pyloric region. The formation of these growths has been attributed to a chronic gastritis, the tumor being formed at the expense of the glandularis and submucous coat. The latter form of myxomata is not so rare, Epstein having noted it in 14 out of 600 autopsies. They are generally found in middle

PLATE LXXXII.



Papilloma near the pylorus. The growth was about the size of a large elongated walnut and was pedunculated. The growth hangs off from the specimen and presents a secondary warty growth near its summit. The structures in the walls of the stomach were not pathological.



life and are twice as frequently observed in men as in women. They are usually covered with a thin layer of mucous membrane.

**Lymphadenomata.**—Because of their association with sarcoma these growths are clinically the most important of the benign stomach tumors. The benign form (lymphoma) is seen as small nodules scattered over the stomach and usually consist mostly of lymphoid tissue, namely, a delicate reticulum within the meshes of which are numerous lymph corpuscles. The tumors are of a grayish-white color, and soft, yielding a milky-white juice on pressure. Clinically these

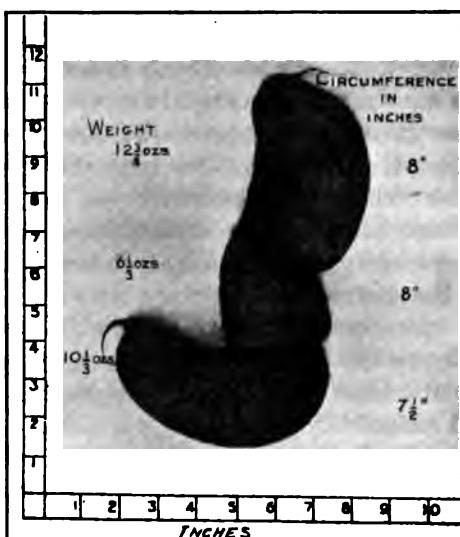


Fig. 131.—The hairballs after removal from the stomach (*Holland*).

growths, for the most part, are innocent, and they are often found in the internal organs in Hodgkin's disease, in which disorder they may also be present in the liver, kidneys, spleen, medulla of bones, lungs, etc., as well as in the alimentary canal. The tumors develop in the mucosa and submucosa, project into the lumen of the viscus, and commonly ulcerate, possibly with the development of a fatal hemorrhage (Reimer's observation). The pedunculated growths may develop to considerable size; a number having been reported as large as an apple. The lymphomata occasionally exhibit malignant properties. This is especially the case in those richly cellular, soft, rapidly growing forms that are sometimes met with. Such growths may rapidly infiltrate the surrounding structures, involve the neighboring lymphatic glands, and

even infect distant parts. To these forms the term lymphadenoma is particularly applied.

**Retention Cysts.**—These are met with in the polypoid forms of chronic gastritis (*gastritis polyposa*). Other cystic formations, such as a gastric dermoid cyst and a multilocular lymphangioma, may be encountered in very rare instances. Albers mentions a cyst  $2\frac{1}{4}$  inches long found in the lesser curvature in a child. Most of the cysts of the stomach, however, are myxomatous in character.

**Gastroliths and Foreign Bodies.**—These are exceedingly rare, are more commonly seen in the insane, but may be encountered in instances of vicious habits, such as swallowing of hair or fiber over lengths of time, or unusual solid articles, and the very rare instances of collections of vegetable detritus. Such collections, of course, are not attached to the stomach, but may be present in such quantities as almost to fill the cavity of the organ. Of these, the so-called "hair tumors" are the most numerous. The vegetable collections consist of starch, vegetable cells, and chlorophyll, but no animal substance. The latter collections are usually rounded masses presenting in the midline of the abdomen (pyloric region). A few cases are on record of diverticula of the stomach. These are very rare, and have only been diagnosed at operation or noted at autopsy. These formations are acquired and usually seen on the distal side of some contracting formation (cicatrix or perigastric band). They may be quite large, and are always free from external adhesions.

**Hypertrophy of the Pylorus.**—Of these cases there are two clinical types, the acquired hypertrophic stenosis of the pylorus accompanying a hypertrophic gastritis, and the congenital type; the latter form will be found described elsewhere. Unless the obstruction is removed by operation the consequences of hypertrophic stenosis may be and generally are as serious as pyloric stenosis due to malignant disease. Pathologically, the process is one in which the normal tissues of the gastric walls are replaced by proliferated fibrillar connective tissue, the thickening being greatest at the pylorus, although the entire organ may be smaller from general involvement and contraction. The pyloric wall may be 2 or 3 centimeters in thickness, the main bulk being made up by hypertrophy of the muscular structures. The disease occurs mostly in persons between twenty and forty years of age, and in males somewhat more frequently than in females. Chronic alcoholism is a prominent factor in the production of most of the cases. The glandularis is commonly much ulcerated in the pyloric region.

**SYMPTOMS AND DIAGNOSIS.**

In the instances of the benign tumors when these are of small or moderate size, no definite symptoms develop and the condition is usually diagnosed at autopsy, after death occurring from some independent affection. In large-sized growths a tumor may be palpable in the epigastrium, particularly in thin subjects. In the large pedunculated growths the polypus may act as a ball valve more or less completely occluding the pyloric region. In these instances the growth may not be felt from without (particularly the mucous ones), may cause a secondary atony of the stomach (dilatation), and the extraction of mixed meals seven, eight, or nine hours after their ingestion or the morning after those taken the evening before would bring forth evidence of stagnation. As a rule, the digestive secretion is not disturbed or a high acidity may exist from condensation. The diagnosis of polyps may sometimes be made by noting detached ones in the wash water during lavage; when extensive polyposis exists, achylia is usually present. The symptoms of benign growths in the stomach usually come on late in life.

Because of the more relative frequency of ulceration in lymphadenoma as compared to the benign tumors, hematemesis with occult blood in the stools may be observed. Gastric saline instillations may produce pus cells and increased bacterial flora; therefore the gas product may be over 2 per cent. Of the foreign bodies, hair balls are most common. In these cases a body may be discovered which is soft and can be moved about. Emesis may frequently occur, and from interference with proper gastric digestion excessive eructations are common. A history of chronic digestive disturbance is the rule. These are the cases in which the use of the gastroscope answers to good purpose, both for diagnosis and removal. This instrument may also serve to splendid use for diagnosis and removal of the pedunculated tumors. In a case that was under my observation of a young man who accidentally swallowed a scarf-pin, the X-rays located the pin in the stomach with the pointed end hanging vertically under the tenth rib and removal was easily accomplished through a straight-tube gastroscope. A number of cases of persistent ingestion of needles have been reported in which the needles were found in various parts of the abdomen, even traveling into the extremities. A case recently reported by Vanivert and Mills had 2.268 grams of metallic articles in the stomach alone. Where the habit has been continuous for a length of time, it is often fatal.

In hypertrophic stenosis the history is that of a chronic gastritis, and a subchlorhydric, anachlorhydric, or achyllic condition is the rule. A definite, small-sized, hard, globular mass (thickened pylorus) may be

palpable in the midline above the umbilicus, or the entire stomach may feel stiffened and unyielding. Fullness, pressure, pain, pyrosis, and eructations are generally present, and rather steady vomiting as the case advances. The appetite may not be disturbed. Small amounts of blood are usually encountered in the test-meals and fecal examinations, and the X-rays, showing a small, triangular-shaped stomach, are valuable in diagnosis. The differential diagnosis between carcinomatous and ulcer stricture of the pylorus would have to be considered, and unless the case is examined exhaustively would be quite difficult. These cases are chronic, and the progress to fatality slow; thus stagnation may not be met with until very late and even then the gastric analysis may not be very conclusive in the way of proving retention.

In the diverticula cases the history of severe pain in the epigastrium after eating, vomiting of a very bitter substance with immediate relief, and a disinclination to partake of solid foods are present when the sac is in the pyloric region. The physical examination is usually negative, but the X-rays would be helpful in diagnosis. Four cases of mine of single benign growths in the stomach were diagnosed by the X-ray, in all of which a difference in density in the bismuth was plainly seen. One case of extensive polyposis showed an irregular outline to the entire stomach, the fundus and duodenal cap being distinct in outline, but the greater and lesser curvatures were hazy. In this case gastroscopic examination showed that almost the entire lining of the stomach was polypoid.

#### TREATMENT.

By the use of the gastroscope the diagnosis of small-sized growths is possible, and in those giving no symptoms no special treatment is required. In the larger pedunculated growths and foreign bodies, when these give symptoms and are not situated in the inaccessible pyloric region or lesser curvature, their removal through a gastroscope by one of the excellent special instruments now used for that purpose may be attempted. When removal in this way is not possible and when the growth is in the wall or a hypertrophic stenosis exists, laparotomy is called for. For pedunculated growths and foreign bodies the stomach cavity should be entered and the growth or bodies removed, and, since the danger of recurrence is very small, the stomach wound can be closed without further surgery. In growths of the stomach wall more or less removal of stomach tissue is necessary and a gastro-enterostomy may be called for when proper stomach drainage cannot be secured.

In hypertrophic stenosis palliative treatment would answer for a moderate case. In this instance the avoidance of everything that

might increase the gastritis should be instituted. Among these is abstinence from alcohol, irritating and hard foods, tobacco, and the use of milk, soft eggs, purées, etc., when HCl secretion exists, and mostly the well-cooked, soft carbohydrates and pancreatin when it does not. Regular stomach lavage with hydrastis or dilute hydrochloric acid answers to good purpose in the routine, particularly when gastric retention is present. In the more severe cases and when the emaciation is progressive and stagnation exists and the symptoms do not abate under medical treatments, operation should be performed. The form of operation depends altogether upon whether only the pylorus is thickened (pylorectomy and pyloroplasty would then be the ideal forms); when the entire stomach is involved in the thickening, the stomach as an organ of digestion and receptacle for food should be disregarded and a free gastro-enterostomy (in preference to a complete gastrectomy) be performed. Should the organ be contracted so high above the duodenojejunal angle as to preclude a posterior gastro-enterostomy, pylorectomy or the Finney operation may be the only forms possible. When stenosis of a high degree exists the operation should not be postponed a single day. After the stenosis has been relieved, the case requires further dietetic, medical, and mechanical treatments according to the consideration of the subject under chronic gastritis.

In the diverticula condition the sac should be excised, and the two sides of normal stomach wall brought together.

## CHAPTER XXIV.

### Infectious Granulomata of the Stomach.

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#### SYPHILIS.

##### ETIOLOGY.

SYPHILIS is an infectious disease, acquired by contagion or transmitted by inheritance, which runs a chronic course, and the lesion of which is an infectious granuloma. In its late secondary and particularly in its tertiary manifestations no organ of the body is exempt from its ravages, and thus of late much attention is being paid to syphilitic affections of the abdominal viscera as well as to organs situated elsewhere in the body.

Of the numerous causes that have been advanced for this pandemic disease (all of which can now be claimed to have been built up on supposition without scientific confirmation), it remained for Schaudinn working with Hoffmann to establish what now appears to be the true etiology of syphilis. Up to this time, as compiled by Lassar, no fewer than one hundred and twenty-five causes of syphilis had been advanced, and thus it was with becoming modesty that Schaudinn and Hoffmann drew attention to the incidence of the spirochæte pallida, leaving the etiological deductions to others, these two German investigators merely presenting the facts they had obtained. Although the presence of this organism had been noted by Borrel, Gonjou and Bordet before that time, no special significance was attached to them, but within six months after Schaudinn and Hoffmann's paper was read before the Berlin Medical Society (May 17, 1905), the spirochæte pallida was proclaimed as the cause of syphilis by many observers all over the world. The vast amount of work on this subject of the last three years has tended to confirm the fact that the spirochæte pallida is present in luetic lesions and not found elsewhere, and confirmation of the etiological accuracy seems to be clinically proven even if the third and fourth laws of Koch still remain unsatisfied. (Osler draws attention to the third law of Koch also not being satisfied with the malarial plasmodium which is now accepted by all as the etiological factor in malaria.)

The spirochæte pallida is a long, delicate, non-refractile, spirally curved organism, pointed at both ends, with an average length of 4 to

$14\mu$ . It is circular on cross-section and the spirillation differs from the more common form of the spirochæte refringens by being more of a corkscrew formation. Both in the stained and fresh specimens, flagellas have been seen which are somewhat shorter than the entire length of the organism, and these are usually attached one at either end. The organism is motile, the movements being a rotation on its long axis, a whip-like undulation of the whole body without locomotion, and forward and backward movements. Unlike other spirilla, the spirochæte pallida retains its spiral form when at rest; the movements gradually disappear on exposure to the air, but may persist in a normal salt solution for six hours. They are seen as free organisms not connected with tissue cells, but may be noted intimately embracing the red blood-corpuscles. One of the marked features of the organism is its obstinacy to stains, the usual methods of staining being ineffectual in coloring them at all, or giving only the very faintest hue and then fading quickly.

It is not within the province of this volume to enter into the technique of staining smears from initial lesions or the tissue from cases of congenital syphilis. Only the subject as it pertains to the internal organs, which are all late manifestations, will be dwelt upon, and because in a severe case the blood examination may offer a valuable clinical examination only the technique of this will be given. For this purpose blood is removed from one of the arm veins (median cephalic, the arm first being constricted by a tightening bandage above to engorge the vessel) by means of a medium-sized (15 cubic centimeter) graduated syringe and a fair-sized aspirating needle. When 1 cubic centimeter of blood has been sucked from the vein, the syringe is removed and 10 cubic centimeters of  $\frac{1}{3}$  per cent. solution of acetic acid is drawn up into the barrel. In a few moments after vigorous shaking, the admixed contents are removed, thoroughly centrifuged, and thin smears are made from the sediment. Many methods of staining have been advanced, some being too complicated for clinical work. The MacNeal method is quick, simple and satisfactory. By this the specimen is dried in the air and heated on a cover-glass for forty-five seconds in the following solution:—

Methylene-violet (crude) .....	.25
Methylene-blue (medically pure) .....	.10
Eosin (yellowish) .....	.20
Methyl-alcohol (pure) .....	100.00

It is then dipped in a 1 to 20,000 sodium carbonate solution, swilled in it for one or two minutes, washed with water and examined with a  $\frac{1}{2}$  or  $\frac{1}{16}$  immersion lens. The spirochætes are stained a delicate blue, or

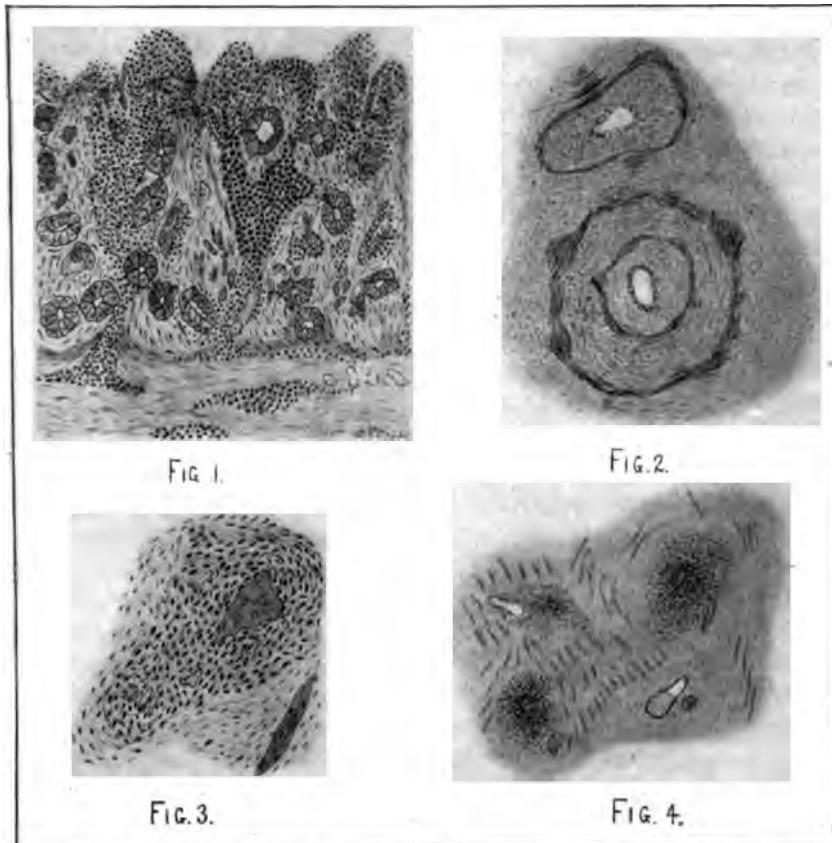
darker if the staining be prolonged. Excellent and quick results are obtained with Goldhorn's polychrome methylene-blue stain, which is prepared as follows: 2 grains of methylene-blue and 4 grains of lithium carbonate are dissolved in 300 cubic centimeters of warm water. The solution is heated in a porcelain dish on a boiling water bath for fifteen minutes, then poured into a glass-stoppered bottle and set aside for several days. Finally it is reduced to slight alkalinity by the addition of 4 to 5 per cent. acetic acid solution (test with litmus paper). The specimens are covered with this dye for three or four seconds, when the excess is drained off. The cover glass or slide is then slowly introduced into clean water with the film side down, the slide is held still in the water for a few seconds, and then shaken in it to wash off the excess of dye. The spirilla appear of a violet color, which may be changed to a bluish black by flooding the preparation for fifteen or twenty seconds with Gram's iodine solution, washing and drying as usual (Simon).

#### PATHOLOGY AND FREQUENCY.

Late syphilitic disease may manifest itself in the alimentary canal, salivary glands and pancreas, in the spleen and liver. An acute parotitis may occur in the secondary stage, and instances of gummata of the salivary glands have been reported. The sublingual gland is more commonly affected than the parotid and usually only as a late lesion. In these instances the secretory function of the glands is not perceptibly interfered with. The pancreas is rarely attacked, the lesion seen being gummatous in character. Syphilis of the esophagus is described in connection with that organ.

The stomach can be the seat of extensive syphilitic disease, but a great difference of opinion exists as to the frequency with which it is met with in syphilitic individuals. As judged from postmortems on syphilitic patients it would seem to be a very rare affection, although of late years the frequency of authentic cases is constantly on the increase. Chiari<sup>1</sup> in 243 postmortems on syphilitic patients found definite stomach lesions in only 2, and up to the time of this writing not more than 30 trustworthy cases of the acquired and congenital forms have been reported in the literature. On the other hand, there are men who assume the presence of a syphilitic gastritis in every disturbance of digestion developing in a syphilitic patient. Judging from therapeutic results in clinical experience, both of the above views are extreme. It must be recalled that syphilis of the acquired form is a common disease and many are the individuals met with who in their early lives have had primary and secondary lesions. Added to these are the great uncertainty

PLATE LXXXIII.



Syphilis of the Stomach.

Fig. 1.—Showing the loss of epithelium, duct and gland cells, and extensive round cell infiltration in the inter- and sub- glandulature regions.

Fig. 2.—An artery and vein showing subendothelial proliferation and infiltration in both vessels, the lumen of each being almost obliterated.

Fig. 3.—Young gumma, highly magnified, showing cell structure and giant cell in center.

Fig. 4.—Miliary gummata in fibrous and muscular tissue.



of the inherited form which was not intense enough in degree to cause the deprivation of life in infancy, and perhaps those who have never presented any clinical symptoms to make diagnosis possible or even suspicious. Masked and latent types of varying degrees of syphilis affecting the internal organs exist in both the acquired and inherited forms, and cases in which the late lesions are more often infiltrative and interstitial rather than gummatous are much more common than the autopsy statistics show, but, of course, they are not so numerous as to warrant viewing every disorder of the internal organs as syphilitic in nature just because no other etiology for some particular disease had been advanced or just because the history of early acquired disease had been obtained. The writer believes, in so far as lesions in the digestive canal are concerned (and possibly also with all other structures of the body), that a conclusive Wassermann test and a favorable result from specific therapy are necessary for diagnosis in the cases of internal organ involvement, and because these have served him well in many more than three-quarters of 1 per cent. of all gastro-intestinal disorders, that syphilitic affections are more common than the autopsies alone would prove, but not so numerous as some have assumed, and that many cases of relatively mild degrees of syphilis compatible with life exist which are liable to correct themselves even without resort to specific therapy. In some of the far eastern countries in which the severe oriental type of the disease is common, specific treatment is not used (or at least not so generally as in the more scientific medical centers), and in these countries, while the rate of mortality of syphilis is highest, still, the very largest proportion of the cases apparently recover, the milder cases oftentimes apparently as successfully as with those handled along lines of specific treatment. The condition occurs three times as often in the male as compared to the female. More than two-thirds are below forty years of age.

In the stomach the disease manifests itself in three types of lesions, namely, a diffuse syphilitic gastritis, syphilitic ulcer, and gumma. To these may be added the sequels of perigastric adhesions or pyloric thickenings causing stenosis. The three lesions will be described singly, but it must be remembered that combinations of the three types are commonly met with.

Diffuse syphilitic gastritis is essentially chronic, may be a primary condition, but is commonly an accompaniment of syphilitic disease of other abdominal organs, or an accompaniment of countless gummata in the mucosa and submucosa. With the stomach involvement, syphilitic lesions usually exist in the liver, spleen and pancreas, and thus Chiari has assumed the condition to be circulatory in nature (indirect syphilis) and due to passive congestions, hemorrhages, etc.,

in which conditions chronic gastritis of a secondary form is so common. However, since gummata and more or less ulceration in the stomach are present with the mucosa infiltration, the condition must also be looked upon as primary. Simple diffuse syphilitic gastritis without gumma or ulcer does not differ histologically from forms of chronic gastritis in which profuse round-cell infiltration of the stomach is observed. But as Hemmeter<sup>2</sup> has pointed out and which I have observed myself, the round-cell infiltration is liable to be more profuse and general in the glandularis and submucosa, and large collections of them may be seen in the latter and extending upward into the secreting tissue above it. Such collections of cells in the submucosa may appear as gummata and the cell infiltration of the glandularis may be pyriform in shape with the base at the submucosa or in fusiform collections above between the tubules. Where a large collection of cells is seen that involves the depth of mucosa, more or less granular and hyaline degeneration of the cellular collection and tissue loss exists, possibly with the formation of ulcer pits.

The possibility of gastric ulcers of syphilitic origin is still in debatable grounds in medicine, but there are many reasons to believe that such ulcers are a pathological entity. Most all of the cases that have been reported are those in which symptoms of ulcer exist in persons who give a past history of syphilis. Simple gastric ulcer and syphilis being such common affections, one would naturally hesitate to associate the two in an individual case. Fenwick has concluded that in one-half of the cases in which the two diseases exist in the same patient there is no direct relationship between them; in my opinion, even this is too high a number of cases in so far as syphilis as an etiological factor in the production of ulcer is concerned. While obviously there is little in the literature in the way of definite association between the two conditions, a few cases of distinct luetic gastric ulcer have been reported (Lafleur, Flexner), and there is some significance in a previous luetic history in the 10 per cent. of Engle's and the 20 per cent. of Lang's cases of gastric ulcer.

Exactly how these ulcers are produced is not definitely established, but it is probably by the breaking down of gummata or round-cell invasion about and in the walls of the blood-vessels and an obliteration of their caliber, shutting off the blood-supply. Frankel<sup>3</sup> has demonstrated this almost pathognomonic change in the blood-vessels. In the report of his case in which gummata of the spleen and thirty-one syphilitic ulcers of the intestine and thirteen ulcerating gummata of the stomach were present, he found that encircling the veins were round, oval, and spindle cells, which penetrated the vessel

walls, causing a thickening of the coats with a partial or complete obliteration of the lumina. In some veins there existed a localized and narrowing endophlebitis, not infrequently associated with cellular infiltration from without. The arterial walls were also penetrated by similar granulation tissue, the degree of alteration being a lesser one. He also found the same vessel changes in a case of diffuse syphilitic gastritis. The description of the ulcers found in both Lafleur's and Flexner's cases were similar, the special features being that the lesions were soft with overhanging edges, a dry bloodless base, and perigastric adhesions being present. This description follows closely the typical forms of chronic ulcer seen in the aged, which also are most probably due to obliterating blood-vessel change.

Gummata, single and of large size, or coalescing, the mass making deposits palpable from without, are no doubt very rare. Of 14 cases collected by Flexner, 5 had positive nodular gummata, one of which was a deposit 8 centimeters in extent. These are generally situated in the pyloric region or along the lesser curvature. They may be seen as circumscribed, elevated, reddish swellings, or flattened elevations occurring in the submucous coat as a dense, compact, soft mass. In the latter instance, the mucosa is thickened, soft, glistening and of a yellowish color, and more or less small-sized ulcerations over them may be noted. On section such masses usually show some fatty degeneration, and even in this instance may be quite firm and whitish on cut surface. In a case in the Krankenhaus Friedrichshain, Berlin, reported by Curtis,<sup>4</sup> in which a gastrectomy had been performed, the following were noted: "Pathologic specimens: The resected stomach, preserved in natural condition in Pick's solution, presented a wall which was everywhere somewhat thickened. The mucosa was mammillated, with gastric areas clearly defined and unusually prominent. On the mucous surface of the opened stomach two flat, longitudinal elevations were seen. One elevation was 7 centimeters in length, with average width of 2.5 centimeters. It was covered with an ulceration which extended through the mucosa, here and there involving the submucosa. The slightly elevated wall of the ulcer was composed of a series of confluent crescents, and was sharply defined, with vertical margin except for 1 centimeter of its length along the upper border, where it was undermined. The base had a thin, grayish coat, the removal of which laid bare the mottled, fatty-looking submucosa. Except at the margins the ulcer floor was elevated to the level of the uninvolved mucous membrane of the stomach. The second elevation lay parallel with and beneath the first. It rose gradually from the brown, plateau-like elevation, 6 centimeters in length and 2 centimeters in width, the end nearer the pylorus being

capped with a small, irregular ulceration. There were no tubercles associated with the ulcers, nor were they to be found on the corresponding serosa. The involved tissue, including the ulcer floor as well as the non-ulcerated elevations, had an elastic, rubber-like consistence. Incision through the thicker portions showed that the increased thickness of the stomach wall was due mostly to changes in the submucosa. Microscopic examination: Specimens were stained with the following: Weigert's elastic tissue stain, hemalum and eosin, orcein, carbol-fuchsin, silver nitrate and pyrogallic acid. The submucosa consisted of coarsely meshed cells, with clearly staining nuclei. It was very richly vascular and, in association with the blood-supply, the characteristic changes were manifest. There were extensive accumulations of round, oval and spindle cells, most numerous in the vicinity of blood-vessels, around which they formed concentric rings, and, invading the vascular coats, greatly increased their thickness. In many veins, and in a lesser number of arteries, the lumen was entirely occluded, an orcein stain being necessary to establish the identity of the vessel. A limited number of vessels on cross-section were free from areolas of cells, while in the case of those longitudinally cut a part of the course might be entirely free, with the remainder surrounded by a rich, cellular envelope.

A subendothelial proliferation occurred in some of the vessels; it involved, as a rule, only a portion of the circumference and took place independently of cellular encroachment from without. The richness of cell infiltration prohibited the determination of submucosa and that portion of the muscular coat adjacent to it contained several accumulations of epithelioid cells bearing characteristics of gummata. They showed no tendency to necrosis, small blood-vessels being numerous and distributed without. Giant cells with peripheral position of the nuclei (Langhans's type of giant cells) were found in association, and in a few instances existed also entirely independently. Among the foreign elements were numerous eosinophiles and also a goodly number of polynuclear leucocytes. The lymph-vessels were distended with round cells; lymph-follicles were numerous, each supplied with easily distinguishable large capillaries. In the mucosa and muscular layers, except for the persistence of a moderate perivasculitis, and the noteworthy accumulations of epithelioid cells found near the submucosa, no changes were manifest. Stains for the spirochæte pallida by Levaditi's method gave negative results. Careful search for tubercle bacilli was likewise negative."

As a result of the syphilitic lesion, cicatrical thickening in the pyloric region or peripyloric adhesions may occur which may cause

obstruction to the normal exit of chyme, with resulting gastric dilatation and stagnation.

Enteritis, intestinal gummata and ulceration with consecutive cicatrization and narrowing of the gut may occur, and in long-standing cases with chronic diarrhea and amyloid degeneration of the intestinal mucosa or organs may be noted. Syphilitic ulceration from mixed infection or the breaking down of gummata with extensive circular ulcers and resulting in marked stenosis is not infrequent. Enlargement of the spleen with gummata in the substance and thickening of the capsule are usually present in syphilis of the liver, and in the latter organ a diffuse interstitial hepatitis, gummata, or scarred and botryoid liver, with or without ascites, may exist. Syphilis, of course, may also affect the respiratory, renal, circulatory, and nervous systems.

#### SYMPTOMS AND DIAGNOSIS OF GASTRIC SYPHILIS.

The diagnosis of syphilis of the internal organs is based upon the history of the initial and secondary symptoms, upon the demonstrations of late syphilitic manifestations, the Wassermann test, and results from specific therapy. The clinical picture as such does not differ in particular ways from non-specific gastric affections, but the results from therapy usually do. There is no question that the more general utilization of the Wassermann test would be most helpful in gastro-intestinal work in the way of distinguishing syphilitic from other forms of chronic gastritis, the syphilitic ulcers from the simple form, and gummatous deposits from other formations in the stomach, particularly malignant disease.

Syphilis of the stomach as a clinical condition occurs late in the acquired affection, although it may be met with early in life in the congenital form. Quite naturally, when, with or without the history of initial lesion followed by the secondary symptoms, the Wassermann test is positive and the case recovers on specific treatment, or in the natal form, when the saddle-shaped nose, prominent forehead, lines about the mouth, Hutchinsonian teeth, disturbances of hearing, history of interstitial keratitis, slender physique, rudimentary beard and scant pubic hair, or the history of many abortions, hydramnios, or giving birth to short-lived infants of a marasmic type is obtained, the diagnosis of internal syphilis is probable or at least suspicious. The benign type of syphilis is even more common in women than in men, and here the initial lesion, throat symptoms, roseola, adenopathy, etc., may have entirely escaped observation. Furthermore, it must be remembered that the acquired form, even when treated the prescribed

capped with a small, irregular ulceration. There were associated with the ulcers, nor were they to be found sponding serosa. The involved tissue, including the ~~the~~ as the non-ulcerated elevations, had an elastic, rubbery Incision through the thicker portions showed that ness of the stomach wall was due mostly to chancres. Microscopic examination: Specimens were stained with Weigert's elastic tissue stain, hemalum and eosin, silver nitrate and pyrogallic acid. The coarsely meshed cells, with clearly staining vascular and, in association with the blood changes were manifest. There were round, oval and spindle cells, most numerous vessels, around which they formed coarse vascular coats, greatly increased thickness in a lesser number of arteries, the orcein stain being necessary to emphasize limited number of vessels on cross sections, while in the case of those cells, while in the case of those might be entirely free, with the familiar envelope.

A subendothelial process involved, as a rule, on independently of cellular infiltration prohibits a portion of the muscle. Tons of epithelioid showed no tender and distributed nuclei (Langhans) in a few instances foreign elements of polyuria. The type of cases is that which closely simulates malignant disease. The pylorus. These may be most severe in progression of distinguishing features. Such gastric pain uninfluenced by the ingestion of food and except for a severe at night. The debility may be marked and the anemia worth noting. The stomach usually shows retention and an absence of charcoal. The stomach acid and pepsin. The epigastrium is usually very painful and, after the condition had existed for some months, a tumor appears at the pylorus. One of the features that distinguishes this type of case from malignant disease is the chronicity of symptoms, some of the cases being ill for from four to eighteen years.

must be said on the numerous gastro-intestinal disorders following treatment by mouth of recently acquired syphilis. It is based upon numerous observations, that the commonly employed caustic salts of mercury and iodides can, in most instances, cure leaving a chronic gastritis from their general argument against the oral method should be considered. The gastritis is in the majority of young patients of a slight extent when the disease is not, and these may remain symptom-free. Of late I have learned, the safest method, better still, however, is intramuscular injection. Unless there is special reason, the mouth should not be continuously used. The average patient is symptom-free. The average duration of the disease on the larger scale, and it may surprise some to note how rapid and malnutrition seen following the secondary stage. The general state of the body is due to a more nearly normal digestion left possible by the better gastric condition.

In its advancement of the Wassermann test of serodiagnosis has been learned to be disputed. The Wassermann method, however, is rather complicated for general utilization in clinical work and has been simplified by a new method by Noguchi.<sup>5</sup> The latter test differs from the original hemolytic system, in being more accurate, and by the use of the anti-human amboceptor, complement, and antigen slips, which make it simple enough for use in clinical work.

In an analysis of 12 per cent. of syphilis cases showing ulcer of the stomach, a similar proportion had hyperacidity with its concomitant symptoms, hyposecretion was present in 19 per cent., vomiting and other symptoms of hypermotility occurred in 15 per cent., symptoms of neuritis of the nerve roots were present in a like proportion, and nearly 21 per cent. had abortive gastric crises. It was found that most cases of gastric ulcer in tertiary syphilis were associated with subnormal acidity. The frequent occurrence of achylia was due to a chronic gastritis. Sensory neuritis giving gastric symptoms was of two kinds—the one involving

length of time (three years), is not always cured, and until the Wassermann test was advanced we had only empirical bases to rely upon. The history of acquired syphilis, evidences of the congenital type, or the history or evidence of such conditions as the late syphilitoderm, tabes, general paralysis and other nervous affections, fissures in the border or dorsum of the tongue, etc., would lead one to consider syphilis as being the cause of the digestive disturbances. The recognition of whether it is or not depends upon the result of the Wassermann test and that of specific therapy. These are the only ways in which diagnosis is possible, and in the presence of such clinical findings it may be possible to relieve or cure certain gastric cases which at first glance look quite hopeless.

Of the findings on examination may be mentioned an achylic gastric content with large amounts of mucus; dilation of the organ with stagnation; a long-standing gastric ulcer in which alcoholism, chlorosis, arteriosclerosis, tuberculosis, and other causes can be eliminated, and which did not bleed and had not recovered on the ulcer treatment; a small-sized, irregular-shaped, movable, pyloric growth which had existed for some time and was not relieved by therapy or does not enlarge and cause the development of the constitutional symptoms that the malignant growths do, and a chronically enlarged spleen and impalpable left hepatic lobe with abdominal ascites which cannot be accounted for as due to other diseases. Fenwick believes that syphilitic cases that simulate acute ulcer differ in three particulars, the first of which is the extreme severity of pain and vomiting, the second the infrequency of hemorrhage, and the third their obstinacy to ordinary treatment and their great tendency to relapse. An exploratory incision may clear the diagnosis, although (even in the presence of a dilated stomach) when gummata are noted further surgery is not advisable until resort to energetic antisyphilitic treatment has first been made. The same holds true in intestinal syphilis, excepting when marked cicatricial stenosis exists, which always requires operation.

An interesting type of cases is that which closely simulates malignant disease of the pylorus. These may be most severe in progression of symptoms, with gastric pain uninfluenced by the ingestion of food and which is worse at night. The debility may be marked and the anemia pronounced. The stomach usually shows retention and an absence of hydrochloric acid and pepsin. The epigastrium is usually very painful on pressure and, after the condition had existed for some months, a tumor at the pylorus. One of the features that distinguishes this type of case from malignant disease is the chronicity of symptoms, some of the cases having been ill for from four to eighteen years.

A few words must be said on the numerous gastro-intestinal disturbances that are seen following treatment by mouth of recently acquired syphilis. It is my belief, based upon numerous observations, that the long continuance of the commonly employed caustic salts of mercury and possibly also the large doses of iodides can, in most instances, cure the syphilis, but at the expense of leaving a chronic gastritis from their use. While this is not offered as a general argument against the oral administration of these drugs, still, it should be considered. The gastritis developed is medicinal in causation and in the majority of young and strong individuals clears up to a practical extent when the drugs are discontinued. Still, some of them do not, and these may require lavaging, medication, and dieting for the purpose. Of late I have come to the belief that, in so far as the stomach is concerned, the safest salt of mercury to employ steadily is the mild chloride; better still, however, is the use of inunctions or the more recent method of intramuscular injections of either the soluble or insoluble salts. Unless there is special indication for doing so, large doses by mouth should not be continuously given, but just enough to keep the patient symptom-free. The average patient does no better for the ultimate cure of the disease on the larger doses than with the smaller, and it may surprise some to note how much less are the anemia and malnutrition seen following the secondary stage. This better general state of the body is due to a more nearly normal condition of digestion left possible by the better gastric condition.

Since the advancement of the Wassermann test of serodiagnosis of syphilis its value as a diagnostic measure has been learned to be beyond dispute. The Wassermann method, however, is rather complicated for general utilization in clinical work and has been simplified by a new method by Noguchi.<sup>5</sup> The latter test differs from the original in the use of an anti-human hemolytic system instead of the anti-sheep hemolytic system, in being more accurate, and by the use of the anti-human amboceptor, complement, and antigen slips, which make it simple enough for use in clinical work.

In an analysis of 12 per cent. of syphilis cases showing ulcer of the stomach, a similar proportion had hyperacidity with its concomitant symptoms, hyposecretion was present in 19 per cent., vomiting and other symptoms of hypermotility occurred in 15 per cent., symptoms of neuritis of the nerve roots were present in a like proportion, and nearly 21 per cent. had abortive gastric crises. It was found that most cases of gastric ulcer in tertiary syphilis were associated with subnormal acidity. The frequent occurrence of achylia was due to a chronic gastritis. Sensory neuritis giving gastric symptoms was of two kinds—the one involving

the posterior dorsal nerve roots, the other the vagus and producing abortive gastric crises.

Einhorn states: "There is no absolute sign distinctive of gastric carcinoma (excepting a microscopic tissue section) which may not be encountered in a gummatous tumor of the stomach. In two cases all clinical signs of gastric carcinoma were present in a clear-cut manner. In one of them even the Wassermann test was negative, and the macroscopic appearance of the tumor after opening the abdomen tallied with an inoperable carcinoma. In the other the X-ray findings, likewise, indicated the presence of a malignant neoplasm. The lesson to be learned from these cases is, not to forget the possibility of gumma, in making a diagnosis of cancer of the stomach. A positive Wassermann reaction is helpful in establishing the diagnosis of a syphilitic lesion. Its absence, however, does not positively militate against lues; nor does its presence indicate that the gastric affection is a syphilitic one."

"A rigorous antiluetic treatment carried out over an extended period of time (2 to 4 weeks or more) gives us the desired information with regard to the differential diagnosis. If there is general improvement and with it a perceptible decrease or disappearance of the tumor, then we are entitled to make the diagnosis of gastric syphilis. The anti-specific treatment leaving the patient in a *status quo*, or perhaps increasing the symptoms, it will rather bear testimony against a luetic nature of the affection in question. Patients with distinct syphilis frequently suffer from other organic lesions of the stomach which are entirely independent of the co-existing general lues. They, therefore, require the usual measures of procedure and treatment in addition to the anti-specific régime."

Among the differentiating points mentioned is that a syphilitic stomach lesion is generally associated with deficient or lacking acidity, while hyperacidity is more common with ordinary gastric ulcer. The syphilitic affection usually can be traced to a syphilitic gastritis during the secondary phase. Other characteristic features are the result of irritation of sensory nerves, periodically recurring pains and vomiting, with a sense of oppression in the stomach region. The effect of vigorous measures to combat the syphilis is peculiarly gratifying in this form. Gastric crises were pronounced in 37 per cent. of the 18 cases of tabes on which the article is based. In 6 the gastric acidity was normal, in 7 below and in 5 above normal. In an additional group of 7 other cases of tabes without gastric crises, but with various stomach symptoms, there was sub-acidity in all but one case. Thus there was subnormal gastric secretion in 52 per cent. of the total 25 cases. In 106 other syphilites with more or less disturbance on the part of the stomach there was hyperchlorhydria in 15.1 per cent. and subacidity in 22.6 per cent.; symptoms suggesting

irritation of the nerve roots in 18.9 per cent. and abortive gastric crises in 31.1 per cent. Achylia seems to be comparatively frequent in syphilitics. Chronic gastritis is probably responsible for it. Other characteristic features of syphilitic disturbance in the stomach are pains from irritation of the nerve roots; the pains have nothing really to do with the stomach but the patient refers them to the stomach. Also sensory phenomena from irritation of the vagus, which amount to actual abortive crises. Signs of irritation of motor nerves, outside of the typical crises, are also characteristic of syphilitic mischief. Hypersecretion and the accompanying symptoms, on the other hand, testify to an ulcer in the stomach regardless of whether syphilis is present or not.

Perhaps the most definite symptom is pain, which in three-fourths of the cases comes on immediately after meals. In uncomplicated gummatous ulcer-type the pain features simulate those of benign ulcer, being intermittent, rather periodic and delayed in appearance, after meals one to three hours (it is not relieved by alkalies or food as in ulcer).

The next most important symptom is vomiting which occurs in four-fifths of the cases. Vomiting of blood by mouth is most uncommon. Flatulence is a definite complaint in 60 per cent. and usually present after meals. The appetite may be good, variable or poor. Loss of weight is present in all cases, but the course is more gradual than malignant disease and the degree of cachexia and diminished strength—mild and out of proportion to loss of weight—in this way it differs from cancer. A palpable tumor mass is present in only a small proportion of the cases.

A consistent achylorhydria, in fact, achylia, seems almost exclusively characteristic of luetic gastric disease. Special study has been made of gastric chemistry in syphilis of the stomach by Barbier, Robin and others, but to date no definite conclusions have been reached, owing to the variable findings. In the majority of cases in which the diagnosis was verified by post-mortem examination or through the study of resected specimens the gastric analyses reported by many competent observers showed absence of free and combined hydrochloric acid. The pathology ranged from circumscribed gummatous ulcers with or without stenosis to diffuse infiltrated and contractured types. On the other hand, fairly convincing case reports by recent contributors to the subject showed the presence of free acid in normal or subnormal amounts. It is reasonable to presume that the extent and the situation of the local involvement and the systemic influence of the syphilitic virus are factors determining the gastric chemistry. However, the preponderance of evidence favors marked reduction of the gastric secretion, either through inhibition of the function of the gastric gland or atrophy of the mucous membrane. This probably has its

inception in a gastritis granularis which may be a manifestation of the secondary or tertiary stage, as the direct or indirect result of the infection. Virchow recognizes an acute syphilitic gastritis which appears in the form of inflammatory infiltration, reddening of the mucous membrane, swelling, etc., and which belongs to the secondary stage. Chiari has described a diffuse and gummatous gastritis as belonging to the congenital form. In gross gastric lesions the more or less diffuse gummatous infiltration of the submucosa which finally extends to the mucosa or the diffuse syphilitic infiltrated type would at an early period affect gastric secretion. An atrophic mucosa was characteristic of all our microscopic sections. Neugebauer recently made a study of the gastric contents of 200 syphilitic recruits. Sixty-two per cent. of them were in the secondary stage and showed definite subacidity. In 17 per cent. there was complete absence of hydrochloric acid or mere traces. Brugsch and Schneider in a review of the gastric chemistry of 100 tertiary syphilites conclude that the frequency of achylia in tertiary syphilis in all probability is due to a chronic gastritis, and that a benign gastric ulcer in the presence of systemic tertiary syphilis is associated with diminished secretion of hydrochloric acid. This argument has been advanced that the absence or reduction of the hydrochloric acid and ferments occurs only in advanced cases; that it is due to the rapid emptying of the gastric contents and involvement of the fundic glands, especially in the high contracted or hour-glass types. This explanation does not suffice because the same findings are present in early uncomplicated cases.

Of some value is the X-ray examination of the stomach. So varied are the lesions, however, that no characteristic plate findings can be mentioned. Those which simulate malignant disease have been met with by me the most often. They have been from these all the way through various stomach deformities to plates that looked practically normal. So the X-ray examination is not conclusive, although it often designates an anatomical lesion, and it is a good clinical rule to follow that when such are met with a Wassermann should be done as a routine. Where there is any doubt, this and the globulin test should be done on the spinal fluid.

As known active syphilitic blood is not available in many communities, the butyric acid test advanced by Noguchi may be employed. For this purpose the blood-serum is rendered free from hemoglobin and 1 part is mixed with 9 parts of a half-saturated solution of ammonium sulphate, the precipitated globulin centrifuged with a powerful machine, and the compact globulin fraction separated by decantation of the supernatant fluid. The deposit may now be weighed. It is then redissolved in 10 parts of 0.9 per cent. salt solution, and is ready for the test. The test is made by mixing 1 part of the solution with an equal part of 10

PLATE LXXXIV.



hilitic hour-glass with obstruction; male, age 38; probably hereditary. Gastric symptoms fourteen years: pain and emesis, achylia. Wassermann ++++. Marked improvement after prolonged course of treatment. Gain 40 pounds. Recovery not complete, probably because of the obstruction present. No reray. Operation not necessary. The illustration shows a markedly dilated esophagus; this is most characteristic of the appearance of gastric syphilis. (After Eusterman.)

Luetic hour-glass stomach. Male, age 34. Primary lesion twelve years previously: gastric disturbances for 1½ years. Pain, vomiting, nocturnal pain, a few mouthfuls causing fullness. Achylia. No retention. Wassermann ++++. Following intensive anti-syphilitic treatment patient gained 10 pounds, eats all solids, shows marked clinical improvement. Reray three months later. No anatomic improvement. (After Eusterman.)

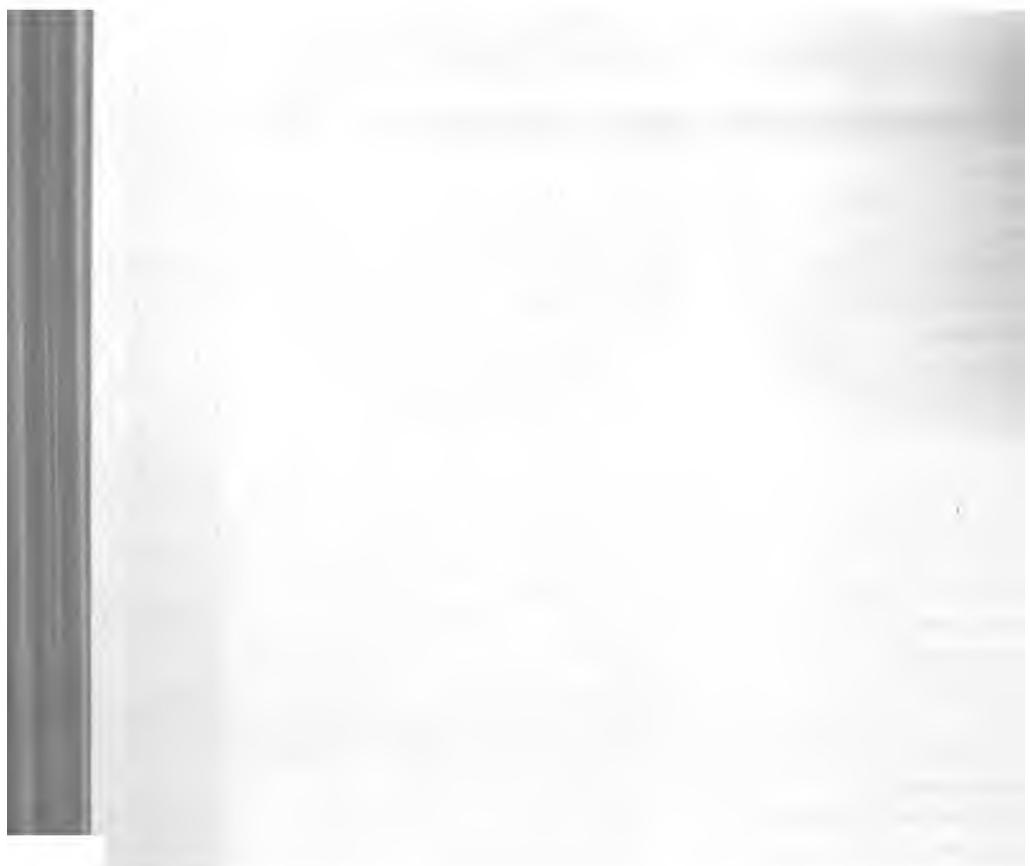
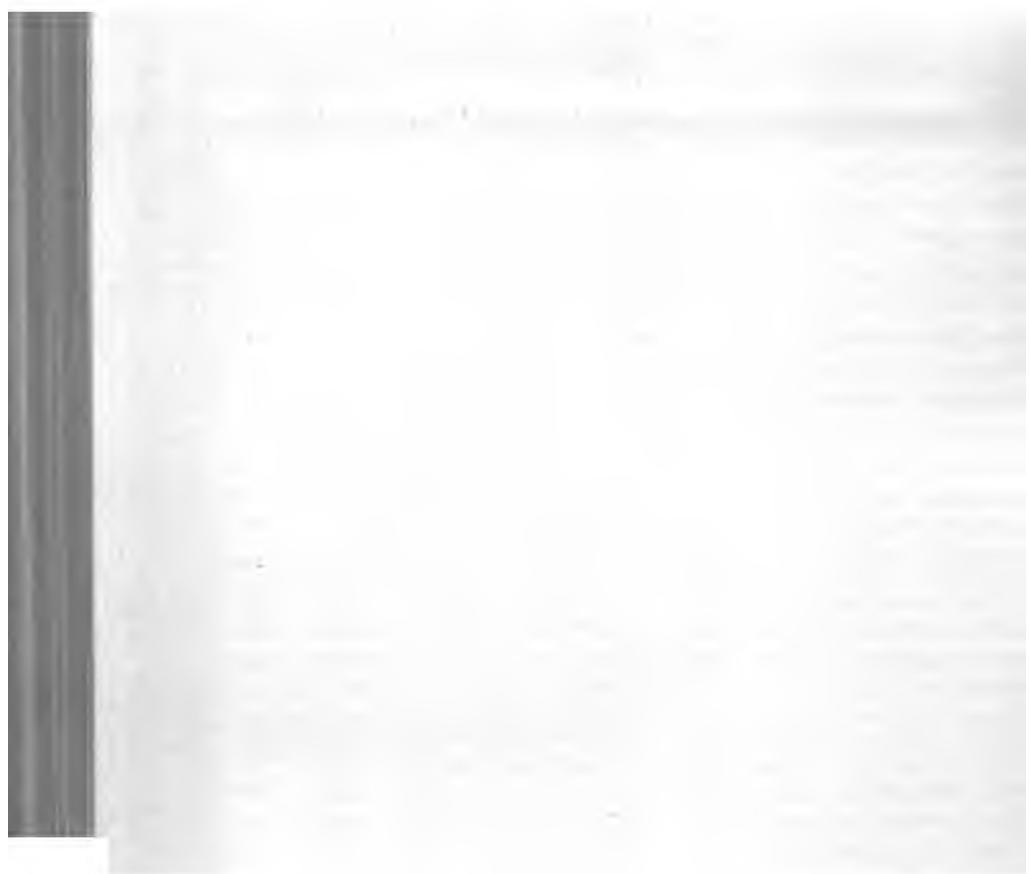


PLATE LXXXV.



syphilitic obstructing gumma of the s. Male, age 41. Primary lesion fifteen years previously, gastric symptoms of two years' duration, progressive. Loss in weight, strength and appetite. Nausea, empty feeling, and burning sensations passing upward into throat three to four hours after meals. Food, alkali, and anal ease, occasional emesis of good es soon after meals. Continuous with brief remissions. Total acids 36, HCl 20. Moderate food residues. Operation Aug. 4, 1917—resection 4½ of the pyloric end of the stomach. Polypoid tumor and multiple shallow ulcers on the mucous membrane side. Operative Wassermann reaction positive. Patient admitted lues which was denied previously. Several courses of mercurials. Marked improvement, finally cured—gain of 20 pounds. (After Eusterman.)

Extensive syphilitic cirrhosis and contractures involving chiefly the middle and lower third. Hereditary syphilis. Male, age 25. Wassermann negative. Gastric disturbances 7 years. Discomfort after eating small amounts of solid foods. Regurgitation, exploratory operation three years previous. Numerous stigmata, moderate symptomatic improvement following antisyphilitic treatment. (After Eusterman.)



per cent. butyric acid solution, when a prompt, dense, milky turbidity appears in the mixture if the serum be from a syphilitic person, while it remains clear or shows only a slight opalescence without precipitation after several hours' standing if from a non-syphilitic individual. In carrying out the test Noguchi recommends the use of 0.5 c.c. of serum and 4.5 c.c. of ammonium sulphate solution, and centrifuging for thirty minutes in a machine which runs at the rate of 5000 revolutions per minute. After decanting the fluid, the deposit is redissolved in 5 c.c. of the salt solution. Of this solution, 0.5 c.c. is to be mixed with the equal part of the butyric acid solution. It is advisable to carry out the examination of several specimens of the fluid at the same time, and to run with them a known normal serum which gives a negative reaction. The centrifugation should be started at a lower rate of speed than 5000 per minute so as to get an equal lay of the globulin deposit. Normal blood has globulin content from 0.12 to 0.15 gram per 0.5 c.c. of the serum, weighed in the moist condition (the weight of dry globulin is about  $\frac{1}{8}$  to  $\frac{1}{9}$  of that of the moist specimens). Syphilitic cases run globulin from 0.2 to 0.35 per 0.5 c.c. In early and latent syphilis the globulin is nearer to 0.2 gram and may be less. Positive tests may be seen in tuberculosis, pneumonia, scarlet fever, Hodgkin's disease, and carcinoma, and because of the latter it is not of as much value in the diagnostic way in the stomach cases as the Wassermann test. Still, it is of value as a negative test to exclude syphilis, and in this it has advantages over the Wassermann, particularly inasmuch as but few of the even advanced carcinoma cases give positive results.

#### TREATMENT.

When there is reason to believe that syphilis of the internal organs exists the treatment should be energetic, simply because the internal manifestations are serious disorders. When the diagnosis is doubtful or when the so-called therapeutic test is to be tried, lesser quantities of mercury and the iodides may be sufficient in the beginning. The salts of the protiodide and bichloride may be given by ingestion for a short time, but when benefit is being derived they should be administered by injection or inunctions. The hypodermic use of from 10 to 30 minims of a 0.4 per cent. biniodide in olive-oil, or 10 minims of a 10 per cent. mercury salicylate in albolene, either injections given every third or fourth day, are efficient. Calomel by mouth (0.065) with a small dose of powdered opium (0.02) taken three times a day is the most beneficial and safe combination for oral use in gastric syphilis, both to cure the case and relieve the local symptoms; it is best given in powdered form.

As internal syphilis in the adult is seen mostly as late tertiary manifestations, the iodides should be given. The power of the drug to dissolve luetic tumors is little short of miraculous. The iodides in moderate-sized doses being better tolerated by the stomach than the mercury salts, they may be administered by mouth preferably in solution. The quantity given should be between 2 and 4 grams (30 and 60 grains) daily and at mealtimes. When in a gastric case benefit is being derived, the daily quantity should be gradually increased to 10 or more grams until the symptoms abate, after which the drug is continued at about the first-mentioned quantity or less. Potassium iodide in saturated solution (1:1) is the most convenient form to employ, and this may be given in milk or essence of pepsin. The popular formula of mixed treatment may be used, but it is usually better in abdominal syphilis to use the insoluble mercury salts (calomel, biniodide) alone and to administer the iodides in increasing doses as may be indicated. The auxiliary treatments, such as dieting, tonics and hygiene should receive attention.

Instead of the mercury and iodide preparations, Ehrlich's 606. salvarsan, or neosalvarsan, may be employed. For this purpose the dose given should not be short of 0.5 gram, and the intravenous method is preferable to the intramuscular. Of course, the usual precautions should be observed in these cases as well as in all others, namely, the eye fundus, urine, and a general physical examination be made first. Because of the specificity of this drug in syphilis, its greater activity in the primary and secondary cases, and the now general employment of it, it is probable that fewer cases of internal syphilis will be met with as time goes on, and also that the number of instances of chronic gastritis brought about by the long administration of mercury and the iodides will be less common.

## TUBERCULOSIS.

### ETIOLOGY.

The first light on the true etiology of tuberculosis was shed by Villemin in 1865 in a communication in which he proved that the disease was a specific affection, that it had its origin in an inoculable agent, and that it could be inoculated from man to rabbits. Following this, much work was done by many experimenters, but it remained for Koch to demonstrate the existence of the tubercle bacillus as the specific cause of the disease.

The tubercle bacillus is a minute colorless rod with rounded ends, and in length about one-fifth the diameter of a red blood-cell. Its

most striking peculiarity distinguishing it from other bacteria is its power to hold aniline dyes in spite of exposure to acids ("acid fast"). The human type is longer than the bovine and grows more readily on all media, producing higher acidity in broth culture. It is resisting to temperatures, the lowest temperature for destruction being 55° C. (131° F.) of moist heat acting for a period of six hours; dry heat is borne to 100° C. for an hour without killing the bacillus. The tubercle bacillus is not destroyed by any degree of cold. They can, however, be destroyed by the normal gastric juice in a test-tube and this result is due to the hydrochloric acid and not to the enzymes. Under natural conditions in the living stomach, because of the short stay, the varying amounts of acid in different stomachs, and their mixture with food, there is little likelihood that we can depend upon it that all of many swallowed tubercle bacilli are killed. The paths of infection are three: inoculation of skin and mucous membrane surfaces, the pulmonary alveoli, and by ingestion. Varying views as to the frequency in which the disease is contracted through the different paths of infection are held, most observers agreeing, however, that infected milk holds the most prominent place in the disease of infants and children, and infection by dust depositing upon the upper air-passages, and infected foods, the organisms gaining entrance through the mucous membranes of the digestive canal, being the most important in adults. Foci of tubercular infections may exist in latent form in any tissue of the body, and under conditions of lowered general or local resistance may become active, with extensive local surrounding or general involvement. It has been computed that 50 per cent. of the general population acquire an actual implantation of tubercle bacilli at some time during life.

#### PATHOLOGY.

The action of the tubercle bacillus on the tissues in its essentials is similar to that of most infectious agents. It is inflammatory in nature, and the most characteristic result is the formation of minute grayish and translucent nodules of firm consistence called the miliary tubercles. Such nodules vary much in size, some being too small to recognize with the unaided eye and others again being quite apparent. In a short time after formation the tubercles lose their translucent character in the center, with the formation of a grayish or yellowish-white opacity, the beginning of the ultimate necrosis or caseation.

Microscopically, a miliary tubercle is composed of a concentric mass of cells having a long, oval and vesicular nuclei. Among the cells which make up the mass of the tubercle, especially at the outer

portion of the nodule, may be seen numbers of relatively smaller cells with large nuclei, and at the poles of the protoplasmic mass the well-known giant cells described by Langhans and Schuppel. These latter are irregular in shape and are provided with a number of nuclei, sometimes as many as twenty in number. The tubercle bacillus can usually be demonstrated in the tubercle. Other tuberculous formations occur which are more exudative or acutely inflammatory in nature, and in the gastro-intestinal tract ulceration of mucous membrane is the rule. No tissue of the body is exempt from involvement, but in this connection only that of the salivary glands, the mouth, esophagus, stomach, intestines, pancreas, liver, and gall-bladder will be considered.

Of late, tuberculosis of the salivary glands has been shown to be a not uncommon affection. The parotid is most frequently affected and the submaxillary less often. These glands in infections by way of the general blood-stream may become the seat of miliary tubercles, or the disease may occur by infections from the mouth by way of the gland ducts. The pathological change noted in most cases is a diffuse form with caseous infiltration, softening and scarring, or as a focal lesion forming a caseous, isolated nodule. Unless the gland is extensively infiltrated by the lesion, the secretory function is not interfered with. From the mouth infections the condition is usually unilateral, and bilateral in those from the blood-stream.

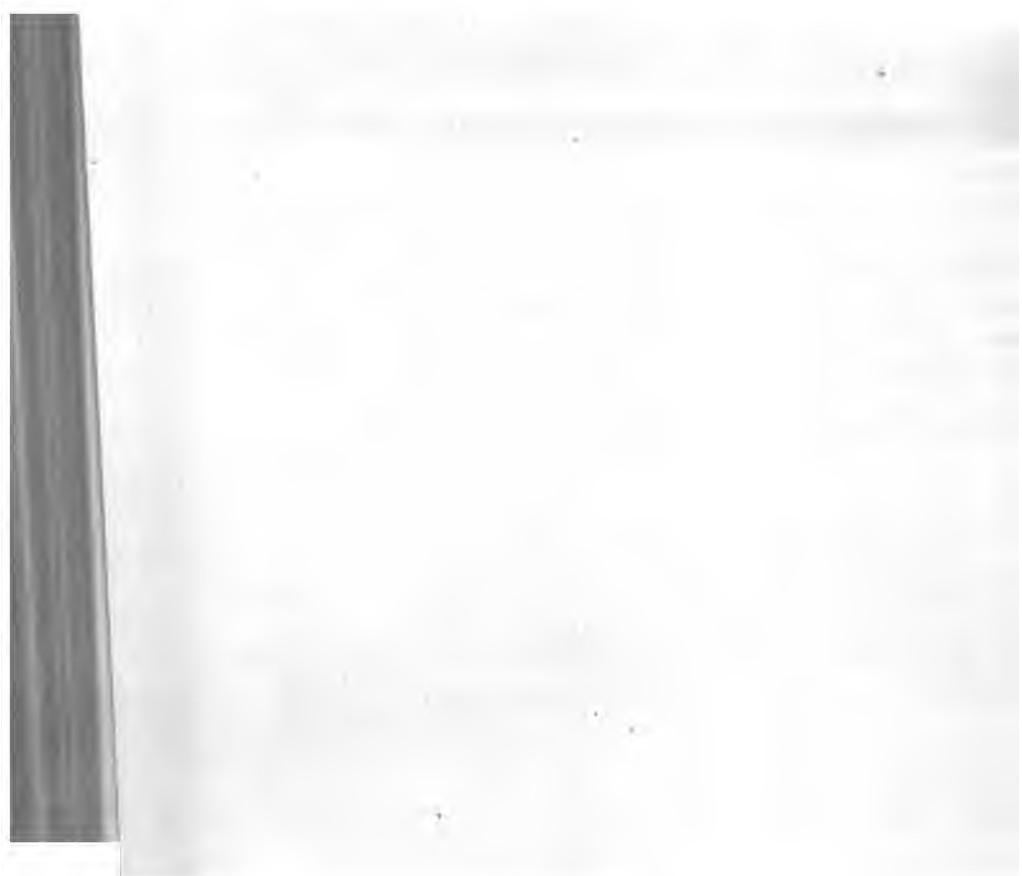
Tuberculosis of the mouth generally manifests itself in the tongue. It is a rare affection and usually due to direct inoculation by tuberculosis sputum. The disease appears as submucous nodules (tuberculomas), which in time ulcerate. The nodules may be single or multiple, and may remain stationary for a long time. When ulceration has taken place they are inclined to be painful, and miliary tubercles may be noted at the margins of the shallow ulcers. Tuberculosis may also appear on the flesh of the gums or on the soft palate.

Tuberculosis of the esophagus is surprisingly rare when one considers the commonness of pulmonary tuberculosis in which the swallowing of infected sputum and food always exists, and the liability of injuries from food in the mucous membrane of the gullet. Inoculation may occur directly by the swallowed bacilli finding lodgment upon the mucosa, or indirectly by extension from bronchial lymph-nodes, trachea, vertebrae, or even the lungs. In miliary tuberculosis it may also be the seat of numerous tubercles. As a rule it is an affection of the esophagus found late in the history of chest disease, and the lesion is mostly ulcerative in character. Thus, in a tuberculous patient of an advanced type, when severe pain on swallowing exists and laryngeal involvement can be excluded, the condition should be thought of. In

PLATE LXXXVI.



Stomach in a case of gastric tuberculosis. Note small size of stomach, and its retraction and anchoring under the liver. The capacity of the stomach was about 300 c.c., and the patient could not ingest more than two or three mouthfuls of food without feeling distended and having to vomit for relief. The stomach was so small and high that the entire length of the duodenum was visible. The anchoring was due to a tuberculous mass between it and the under surface of the liver. Note deep shadow between stomach and liver. (Made in the author's X-ray department).



ises that recover from the tubercular conditions a stenosis of the : from cicatricial contraction may be left.

Tuberculous ulcers of the stomach are comparatively rare, they found in about 2.3 per cent. of autopsies upon tuberculous its. Several reasons for this rarity have been advanced, the most le being that more or less of the bacteria are destroyed by the ic juice and that unless there is a pyloric lesion lowering the local ance at that site the bacteria are prevented from settling and grow- i the mucosa. Added to these Barchasch<sup>6</sup> has drawn attention to : scarcity of lymphatic follicles in the stomach walls and the motility : organ which insure a comparatively short exposure to infection. eequently, motor insufficiency and chronic gastric catarrh, par- rily gastritis granulosa, in which there is an increase in the hoid follicles, are among the most important predisposing factors e establishment of a tuberculous process. Although gastric in- ment is usually secondary to pulmonary disease and occurs as the of the constant swallowing of infected sputum, a number of cases imary gastric tuberculosis have been reported. Martin<sup>7</sup> states, naps 20 per cent. of patients with ulcer die of tuberculosis and in of 22 fatal open ulcer cases in Montreal pulmonary tuberculosis ed, but in over one-half of these it had no relation to the cause ath."

Five anatomical varieties of tuberculosis of the stomach have described: (a) The ulcer, sometimes single, oftentimes multiple, is rather small, with irregular outline, elevated, somewhat underl, with indurated margins and rough base, and in which tubercles be noted. On the other hand, in rare instances, such an ulcer be small and deep, eroding a large vessel. (b) Miliary tuber- s, due to the tubercle bacilli gaining the blood-stream and the nination of the organisms throughout the body and their deposi- n the various internal organs, in which they form tubercles. These be noted in the stomach as small millet-seed formations on the onal surface or along the paths of the vessels in the stomach . (c) Solitary tubercles which are exceedingly rare and probably o local infection from infected sputum. They are found in the ach walls. (d) Tumor-like masses, usually in the pyloric region, i very closely simulate carcinoma. Such formations are usually o large tubercular deposits, perhaps adenomatous, with an extent nnective tissue in addition. As the pylorus is more richly sup- with lymphoid tissues than any other portion of the stomach it t unlikely that a number of cases of inexplicable stenosis are culous in origin. (e) Tuberculous cicatricial pyloric stenosis

from more or less healed lesions or contractions of perigastric bands due to them." A number of the small tuberculous ulcers are usually present in the stomach at one time, and they are most often found along the lesser curvature and posterior wall. They are flat, with slight or no elevations, with the floor composed of yellow or gray tubercles, and a thickened submucosa. Scrapings from the ulcer bases display large quantities of tubercle bacilli, and the giant cells are occasionally met with in the substance of the tissue under them. In fewer instances rather large sized single ulcers are seen, these being of the indolent type and up to 5 centimeters in diameter. When the stomach is involved with ulceration, the ileum, colon, spleen, and pancreas may be similarly affected. Where tubercles exist on the peritoneal surface of the viscera, adhesions with the mesentery and omentum are commonly met with which bind a number of structures into an inseparable mass.

Intestinal tuberculosis is the most frequent of all complications of chronic pulmonary tuberculosis. It occurs in various forms, the commonest of which are areas of concentric hypertrophy, stenosing or deforming cicatrices, and tumor formations resembling malignant growths. Tubercles may also be found in the rectum, liver, and gall-bladder. In the latter instance gall-stones are usually also present. Tuberculosis of the liver, although a common affection, is rarely diagnosed during life, and that of the gall-bladder practically never. If ulceration and subsequent stenosis of the rectum take place, diagnosis is possible, although most of these lesions are simple, malignant, or syphilitic in nature.

#### SYMPTOMS AND DIAGNOSIS OF GASTRIC TUBERCULOSIS.

It is rather interesting to recall that with the large number of cases of pulmonary tuberculosis and the number of tubercle bacilli that are swallowed, more cases of gastric tuberculosis do not occur. Many reasons for this rarity have been advanced, in which the destruction of bacteria by the gastric juice and absence of a pyloric lesion are not completely satisfactory. In my experience the absence of gastric juice is a common finding in late pulmonary tuberculosis, and if the first were true more instances of gastric tuberculosis should be noted.

A gastric ulcer which persists in giving symptoms after a full course of the Leube or Lenhardt rest cure is in nature either tuberculous, syphilitic, malignant, or the chronic form of ulcer accompanying senile vascular change. There are no distinct symptoms of gastric tuberculosis, excepting possibly the chronicity of the ulcer course and, like the syphilitic ulcers, they are not so liable to bleed as the simple, malignant or the chronic forms. Naturally, in an ulcer case if evidence

of tubercular disease exists in other portions of the body than the abdomen, one should think of the lesion in the stomach being tuberculous in nature. In gastric ulcer of a tuberculous nature the pain is liable to be of a severe character.

If stenosis of the pylorus exists and a tumor is palpable one must think of local tuberculosis as well as malignant disease. Often at operation a mass which is impossible to remove or explore may be present in the post-pyloric region, and thus diagnosis of its character would not be possible. It should not be forgotten that primary atony of the stomach may secondarily follow other infectious diseases, such as typhoid fever and tuberculosis, and that most instances of dilated stomachs in these diseases must be considered as a result of the toxemia and subnutrition rather than the result of local gastric affection. The finding of tubercle bacilli in the gastric contents serves to no diagnostic purpose, because in pulmonary tuberculosis they are swallowed in the sputum or with the food and drink, thus accounting for their presence at times.

There is little to be said in any definite way concerning gastric tuberculosis, but matters pertaining to the diagnosis of tuberculosis in general may serve of importance in individual cases. Among these are, the persistent, slight elevation of temperature without apparent cause and with its highest point about 4 o'clock afternoons; a steady loss in weight and strength; the chest symptoms of cough, hemoptysis, dyspnea, pleurisy, the examination of the sputum and the physical signs; and the tuberculin test.

In unhealing ulcers of the stomach or intestines the tuberculin test offers the only possibility of diagnosis. Doses of tuberculin prepared, according to Koch's directions and standardized, in ascending quantities of 0.001, 0.003, 0.005, 0.008 and 0.01 cubic centimeter, well diluted, should be given. The reaction of temperature rise (37.8° C. or 100° F. or more) should be sought for from eight to twenty hours after the injection and at intervals for seventy-two hours afterward. If the patient fails to react on one quantity the next larger-sized dose should be given until several doses have been administered. In addition to the mentioned test the recently advanced ophthalmic and the von Pirquet tests may be employed, the latter being the safer one.

#### TREATMENT.

It must be plain from what has already been stated concerning gastric tuberculosis and the great dangers of intestinal complications, that persons with pulmonary tuberculosis should be warned against swal-

lowing sputum, and advice should be given to thoroughly cleanse the mouth and fauces before eating and drinking. There is nothing special to be added concerning the medical treatment of tubercular affections of the abdominal organs to what has already so universally been advanced on the treatment of this broadcast disease. The far-reaching medical propaganda against tuberculosis has instilled thoughts of its dangers in the minds of the intelligent and thinking public. The continuation of the modern hygienic and dietetic principles of prophylaxis and treatment, the isolation of patients, and their instruction and observance of the dangers of carelessness in handling infective discharges will eventually bring tuberculosis into the category of the rare diseases. In no one field of medicine is the profession now serving the public so well. The elimination of tropical diseases is of course important, but it is in the work being done against this so-called "house disease" that the greatest degree of medical service is now being rendered.

Because of the seriousness of abdominal tuberculosis it seems justifiable to use tuberculin for therapeutic purposes. But tuberculin is a most powerful agent and demands the greatest care in its administration. Only the slowest increase in dosage should ever be employed, and the slightest untoward departure of the patient from the usual course should be seriously considered. It should only be used in the afebrile cases and when the state of general nutrition permits. The dose should be begun at 0.0001 or, better, 0.00001 cubic centimeter of the O. T. form, given every third day, and gradually increased until the tolerance is reached. The B. F. form has been advised for the febrile cases. The treatment should be continued for at least three months, and the hygienic-dietetic treatment faithfully followed throughout the course. I have seen 2 cases of gastric tuberculosis. Both were accompanied by slight elevation of temperature, loss of weight and strength, the chest symptoms of pulmonary tuberculosis, and positive tuberculin tests. They were operated on because of the prominence of the gastric symptoms, both being relieved by a gastro-enterostomy, but both eventually ended fatally of tuberculosis. I am inclined to feel that beyond the general treatment of tuberculosis and the relieving of such mechanical conditions as might exist in the stomach, but little more could be done. Because of the seriousness of gastric tuberculosis, it has seemed advisable to me to use tuberculin in any future case I may have to do with.

In a chronically persistent localized lesion in the stomach surgery would be justifiable. In the case of a persistent gastric ulcer in which the Wassermann test for syphilis is negative and the tuberculin test positive, resort should be made to the general medical treatment of

erculosis, and in failure with these, providing the general condition of the patient warrants surgical procedure, operation should be performed. In the instances at operation in which such an ulcer would be noted or suspected, excision is the operation of choice. Obviously, the drainage operations would offer little in the way of substantial benefit.

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## CHAPTER XXV.

### Congenital Defects of the Stomach and Gastric Tetany.

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#### CONGENITAL STENOSIS OF THE PYLORUS.

As a rule, instances of congenital stenosis of the pylorus are seen only in infancy and childhood, although there is no doubt that a few of the cases of true congenital stenosis pass on to adult years. In the very young it is also probable that pylorospasm without demonstrable tissue atresia can exist and in contradistinction these have been designated as congenital spasm of the pylorus. The first authentic case of the condition was described by Beardsly (1788), after which the disorder did not receive much recognition until the publication of Landerer in 1879, and that of Maier in 1885. Since the latter year, numerous instances of true pyloric stenosis occurring in infancy have been reported in which at autopsy thickening of the general pyloric tissues and tumor formation due to thickening of the longitudinal and circular fibers at that site were noted.

#### SYMPTOMS AND DIAGNOSIS.

In cases of both congenital stenosis and pylorospasm the infants are born apparently well, and evidences of the condition do not appear until from one to four days or even as late as eight weeks after birth. The first symptom that usually directs attention to the condition is more or less vomiting which at first occurs at intervals throughout the twenty-four hours and soon becomes persistent, the infant rejecting more or less of the milk after each nursing. In some of the cases the ejection from the stomach is larger in quantity than is taken at the preceding feeding, pointing characteristically toward retention and collective vomiting. With the constant vomiting there is a steady emaciation, or perhaps a stationary weight particularly when the atresia is not pronounced or the element of spasm is mostly responsible. The vomiting is generally projectile in character, as if caused by a sudden violent contraction of the stomach and a forcing upward of its contents.

Since ordinarily the great majority of infants are breast-fed, particularly in their early days (the literature shows that fully two-thirds of these infants have been breast-fed from the start), the onset of vomiting without cause and which does not respond to dietetic and medical measures and soon becomes a marked feature in the case should immediately awaken suspicion of the presence of the condition. In those who are bottle-fed a greater element of doubt in the diagnosis usually exists simply because a number of infants do not respond successfully to the generally accepted percentage feeding for that age, and also because so little time is allowed to experiment with the food

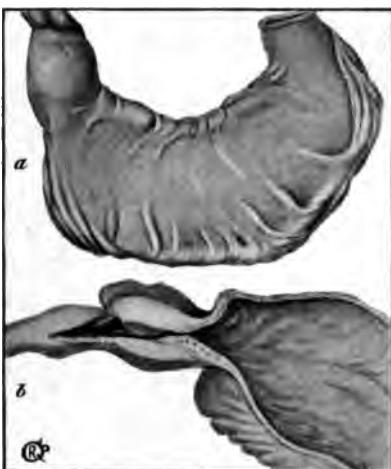


Fig. 132.—Hypertrophic pyloric stenosis in a six weeks old infant.  
(a) Tumor. (b) Longitudinal section, showing hypertrophy of circular fibers and extremely narrow lumen.

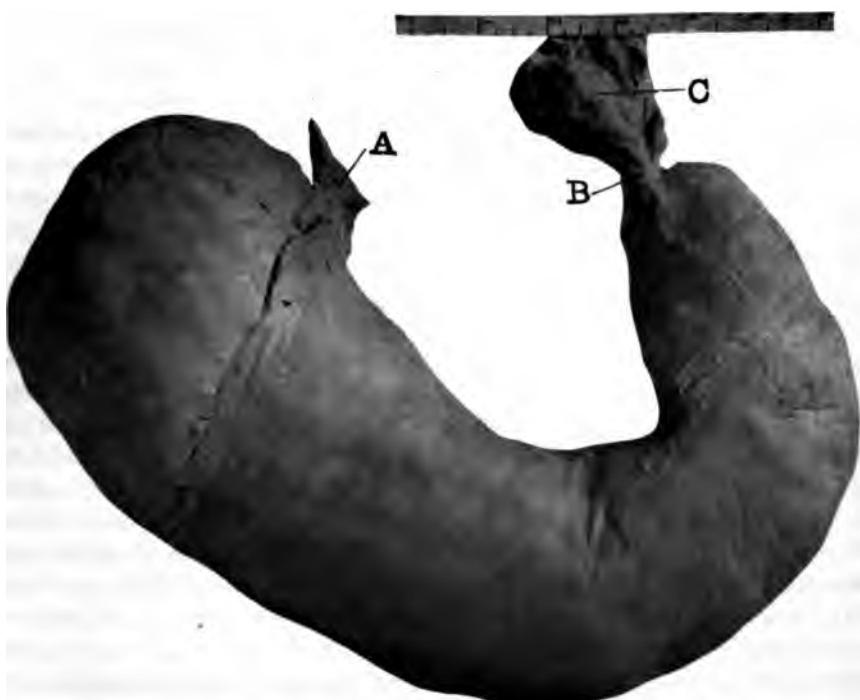
before the symptoms of stenosis have developed. In almost every case, and certainly in the most common fatal ones, the persistency of vomiting in face of the simplest feedings soon suggests the diagnosis. With the vomiting there are other signs of constitutional disturbance. Among these are evidences of pain and restlessness after each nursing, and constipation, or the movements are small, sometimes fluid in consistency, and may be greenish in color. Ibrahim has described singultus in these cases and also eructations of gas; the latter, however, are not important, since they are also common in healthy breast-fed infants. There is no fever.

Physical examination in the majority of instances shows a characteristic condition of the surface of the abdomen. On the introduction of food a gastric peristalsis is usually visible running from

the left costal border, passing forward to Traube's triangle and stopping in a sort of groove. A second wave of peristalsis is taken up at this latter-mentioned point, passing onward beyond the ensiform cartilage and then disappearing downward. Just before ejection of its contents, the stomach may be seen to erect itself in extreme peristalsis, contracting again just before vomiting takes place. On careful examination during this period a small, hard nodule beneath the border of the liver running downward toward the umbilicus may be felt; this represents the pyloric end of the stomach. In some cases and particularly in those with spasm, the peristaltic movements described may not be observed and the pylorus not be palpable or only indistinctly so, and noted only at the time of vomiting and not when the organ is empty. These facts are of much clinical importance in separating the case of simple spasm from those of organic pyloric stenosis. In other cases again which first appear clinically as instances of spasm, distinct gastric peristalsis might be noted when a considerable degree of emaciation has set in.

Most valuable in this connection are the remarks of Koplik,<sup>1</sup> who undertook to reconcile the conflicting theories of this condition to be found in literature in the following matter: "I will take up the question as to whether in these cases there is a spasm or a distinct stricture of the pylorus or stenosis. I believe that there is a set of these cases the subsequent history of which proves distinctly that there is at a certain period of the illness a spasm of the pylorus and of the stomach at its pyloric end; that for certain reasons this spasm subsides and under favorable conditions the children cease to exhibit further symptoms of their condition, and recover. In other cases, in addition to this spasm of the pylorus there is added also a distinct anatomical condition in which the structure of the pylorus is abnormal; the muscular coats as well as the mucous membrane are thickened and thrown into folds, causing a narrowing of the orifice of the pylorus. This, with the spasm superadded, causes a distinct stricture at this point, which in some cases is extreme. In a great many cases, even this anatomical condition sometimes admits of improvement by relaxation of the stricture, cessation of the spastic condition at the pyloric end of the stomach and opening up of the lumen of the pylorus, and a continued improvement of the patient. In other cases this spasm of the pylorus may subside but the lumen of the pylorus remain narrow, and still the children may improve with correct diet. In other words, if the anatomical condition of narrowing of the pylorus is not complicated any longer with a spasm, which exaggerates this condition, a certain amount of food is allowed to pass through the narrow orifice

PLATE LXXXVII.



Markedly dilated stomach due to congenital stenosis of the pylorus. The size of the specimen shows the possibilities to which a stomach may dilate. The organ measured in its long axis nineteen and one-half inches, and thirteen and one-half inches in circumference at its widest part. *A*, Cardia. *B*, Pylorus. *C*, Duodenum. The measure is an inch scale. Adult case.



into the intestine, is absorbed, and the children improve." The author has seen four such children, the youngest 7 months and the oldest 9 years, in whom distinct states of permanent pyloric narrowing existed. These children remained well nourished on fluid diets, and continued symptom-free as long as they did not depart from them. In three the solid foods did not distress them providing they were finely chopped and taken in fluids, but with the fourth these could not be given without causing vomiting in a few hours. These cases are easily diagnosed by X-ray.

What is especially interesting here are the instances of the condition that continue to adult life. Landerer described some autopsies in adult subjects who had lived until the forties which showed at post mortem a narrowing of the pyloric orifice. Of such the author has seen two, one in a male of forty-three, the other in a female of twenty-seven, both of whom died of diseases referable to other organs than the stomach. Although, as in Landerer's cases, these two subjects had suffered from infancy and during all of adult life from the effects of this stenosis, the condition was not suspected and only disclosed at autopsy. The one organ (Plate LXXXVI) was the largest stomach and also the largest of uniform shape that I have ever seen. Sections of parts of the organ showed a perfectly normal condition of the walls, excepting that the musculature was very highly developed in a general manner throughout. The diagnosis of these adult cases is very rarely made, not because diagnosis is so difficult but because the condition is rarely thought of. The diagnosis when made is usually arrived at by the noting of a very large sized, uniform-shaped stomach in good position strongly suggesting megalostomachia. In the latter, however, long delay in the exit of food is not the rule and thus the mixed-meal methods of examination for noting motility or patency of the pylorus would serve to separate the two conditions. Furthermore, an X-ray picture taken so as to bring the pyloric region and the size of the entire organ distinctly into view would be most helpful. From simple atony or dilatation no difficulty will be encountered, because in atony the organ is never so large in size or so uniform in shape, is liable to be more or less prolapsed, and the history of a cause is usually obtainable. Of course, a most valuable point in the diagnosis is the history of digestive disturbance since infancy. A history of stenosis which begins later in life is usually due to other causes than a congenital condition.

The condition in the adults must be diagnosed from other states which may cause pyloric stenoses, gastric atony, and megalostomachia. Test-meal methods and the X-rays serve to distinguish the last two from congenital stenosis. In distinguishing one cause of pyloric stenosis from another when the cancerous states are not considered, much difficulty is

met with, and the danger of mistakes when definite diagnoses of cause are made is greatest. If the case appears as a benign condition chronic in type, temporizing along medical lines may be justifiable for a time. Should improvement not be noted, however, resort to surgery should be thought of, for both diagnostic purposes and cure.

#### TREATMENT.

When in infants the symptoms come on a few days after birth and are intense the disease is most often quickly fatal. Still, in the uncertainty as to whether the cause of the condition is a simple pylorospasm, or a spasm added to an originally narrowed orifice, or the existence of an orifice which is not occluded to such an extent that nutrition is not possible, it is incumbent to institute careful treatment with the double purpose of minimizing the element of spasm and nourishing the infant. The adult cases, in my opinion, are always operable ones providing the symptoms of distress cannot be restrained by dieting or the patient chafes under the long, strict régime. The operations of choice would be pylorectomy or the pyloroplasty.

In infants the dietetic treatment is the most important. Breast feeding should be kept up, but the amount of milk the infant suckles should be strictly controlled, effort being made to keep it short of the amount that would produce tendency of the child to vomit; the feeding also should be at long intervals (every four hours or more). It may be advisable even to discontinue the breast feeding and employ a substitute feeding for the time being, first, because not every breast milk of a mother seems to be adapted to her infant, and, secondly, it may be advisable to restrict the elements of mechanical irritation presented by the presence of the milk curds as well as the difficulty of their passing through the pylorus (even the casein flocculi of mother's milk). For these reasons a well-strained fluid, like vegetable or meat broths, or sweetened water might answer to tide the case over the spasm. To these feedings Koplik adds a little citrate of soda, claiming temporary benefit from its use. The substitute feedings must also be given in small amounts and at long intervals.

Warm applications of flaxseed and hops may be made to the abdomen, and enemas in the form of enteroclysis of normal saline solution are beneficial: the latter may be given several times daily. Gastric lavage is to be discouraged. Drugs are not of much value; still, a very small dose of one of the opium derivatives may be given to quiet the spasm of the pylorus and stomach walls. It must always be remembered with the use of opium that infants are very susceptible to

its action. A slight dose of belladonna or atropine is, in my opinion, of greater service in controlling the spasm and not so dangerous.

Regarding operative therapy in the young the author feels that he could add nothing to Koplik's most sensible conclusions. Although the pediatrician mentioned reports 1 case of congenital hypertrophic stenosis of the pylorus in which operation seemed to serve of signal benefit, he states: "An operation such as is proposed for the relief of congenital hypertrophic stenosis of the pylorus presupposes great technical skill on the part of the surgeon, and great dexterity and rapidity. One surgeon may complete the operation of posterior gastroenterostomy in fifteen minutes, another in forty-five minutes. The difference to the patient can better be imagined than described. Again, a mortality of 50 per cent. (Ibrahim) to 75 per cent. is certainly not an encouraging prospect for the physician to hold up to the anxious parents. We are asked to hand these cases to the surgeon before it is too late. Who will say, and how are we to decide the proper moment when all further attempts to save the patient will be hopeless? I confess, with all my experience with these conditions, I still feel that my chances with nature are as good, if not in some cases better, than with the operative measure. There is another point which I especially wish to consider, and that is that the cutting out of a portion of the gut, which results when posterior gastroenterostomy is performed, is not without harmful influence. The infant who has been recorded in this paper as having been successfully operated upon, did very well up to the eighteenth month of life, and presented no symptoms referable to the operation. He has, however, lately shown an anemia which does not yield to treatment, a rachitis of very marked degree, and is slow in physical development. He presents also respiratory apnea and, what is most peculiar and especially interesting to the surgeons, symptoms which point to a narrowing of the artificial opening in the stomach. The child is beginning to vomit after the ingestion of solid food; even small pieces of cracker cannot be taken without danger of a vomiting spell following immediately or soon after the meal. Meat the little fellow refuses to take, inasmuch as he feels that he will have to reject it. About two years after the operation symptoms of possible stenosis of the artificial opening in the stomach are beginning to develop."

A method of mechanically stretching the pylorus has been suggested by Einhorn which he used with success in an infant 3½ months old, and several adults. The mode of application consists of the swallowing of a string with a weighted end, and after some hours, when the end piece has gained the duodenum so that it holds within when the outer end

met with, and the danger of mistakes when defining rubber bag <sup>re</sup>  
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thought of, for both diagnostic purposes <sup>re</sup> using the pylorus for infar-  
<sup>re</sup> son for the latter is because <sup>re</sup>  
<sup>re</sup> life is a serious matter in <sup>re</sup>

### TREATMENT

When in infants the symptoms are intense the disease is more or less certain as to whether the cause is a spasm added to an obstruction of an orifice which is not possible, it is for the double purpose of providing the or the patient choice would

In infants the cause is muscle. It is therefore evident that the diagnosis feeding should be warrant an operation in the first instance. Even in the cases it is almost impossible to decree that these are also the result states from surgical conditions of other organs in the abdomen; however, only the diagnosis of neurotic pylorospasm (feverish and this is a very rare condition) the use of the pyloric dilator to signal purpose to relieve the local symptoms.

### CONGENITAL ABNORMALITIES IN THE SIZE OF THE STOMACH.

In health the capacity of the human stomach varies within wide limits, but this is most marked in the pathological conditions. As a result of a large number of post-mortem examinations of persons of about the same size who during life had never manifested signs of digestive disturbance, found that the largest stomach had 1000 cubic centimeters (56 ounces), the smallest 250 cubic centimeters (8 ounces), the other figures running between these two. To this belongs the credit of first pointing out that the stomach, whatever how great its capacity, may still functionate properly. To such congenital, or for dietetic reasons, acquired large stomach with normal functions the term megalogastria is given, and this type of

inguished clinically from the dilated organ, also but which is accompanied with digestive disturbance the organ is capable of propelling its contents and that is the main diagnostic point of the stomachs—that is, the normal and enlarged instances of megalogastria are usually detected by X-ray because no symptoms are present under clinical observation, and the motor tests

hand, a few instances of very small sized normal stomachs have been noted. The term angustatio ventriculi, however, particularly refers to the stomach, which, because of esophageal stenosis, has not received bulk enough of food at each meal to allow it to maintain its regular size, or because of a contractured change in the walls of the organ (diffuse hardening, cirrhotic gastritis) has caused a diminution in its size. Of the latter type described by the French a perfect example is shown here. Extragastric tumors pressing upon the stomach could cause a relative diminution in the size of the cavity of the organ, and most common of these are the instances of very large spleen pressing upon the fundic end, omental or pancreatic growths, and gas pressure on the distended stomach by the splenic end of the colon. The diagnosis of both the large and small stomach can be made by instilling the quantities of fluid that may be instilled into the organ, after still, by the bismuth X-ray method of examination.

#### TRANSPOSED ABDOMINAL VISCERA.

The stomach may be found in an abnormal position, either by congenital malposition, or pathologically, such as in cases of prolapse of the diaphragm due to the contraction of perigastric bands or large abdominal growths pressing the organ out of normal location. Among the congenital abnormalities are the very rare instances of partial or complete transposition of the diaphragm in which the stomach may be situated on the right side of the abdomen (pylorus to the left) and the liver on the left. In a case under my observation of diaphragmatic hernia the portion of the stomach could be pressed upward into the left chest. The best means of diagnosis of these conditions is by X-ray.

#### GASTRIC TETANY.

Because of its seriousness, tetany is worthy of special mention. Although the condition is usually a symptom of gastrectasis (gen-

of the string is pulled upon, a catheter with a dilating rubber bag reinforced with a thin cloth is threaded on to the string and passed into the stomach and through the pylorus. The bag is then inflated with air from above and drawn through the pylorus from the duodenal side. I am strongly inclined to favor this means of dilating the pylorus for infants and children, but not for adults. The reason for the latter is because pyloric stenosis manifesting itself in adult life is a serious matter in the great majority of cases and had better not be temporized with by medical measures, but had best be operated upon as soon as possible. Among the cases of pyloric stenosis in the adult I have seen since this method was advanced, the most careful work in diagnosis and length of observation presented two of moderate degrees of stenosis that looked like congenital narrowings. In these the pyloric dilator was used with subjective benefit in both cases. After a length of time with its employment enough symptoms of stagnation when solid foods had been taken remain present to argue against continuation of the stretching. Operation was performed in both cases. In the first, peripyloric adhesions were met with which in the course of time would have closed the pylorus definitely. In the second, a small carcinoma about the size of a hazelnut was disclosed, involving the pyloric outlet and muscle. It is therefore evident that the diagnosis of pyloric stenosis was sufficient in the two very plausible cases for the treatment to have warranted an operation in the first instance. Even in the pylorospasm cases it is almost impossible to decree that these are not due to referred states from surgical conditions of other organs in the abdomen. Where, however, only the diagnosis of neurotic pylorospasm can be made (and this is a very rare condition) the use of the pyloric dilator may answer to signal purpose to relieve the local symptoms.

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organ must be distinguished clinically from the dilated organ, also with large-sized cavity, but which is accompanied with digestive disturbance. In megalogastria the organ is capable of propelling its contents in the proper time, and that is the main diagnostic point between these two types of large stomachs—that is, the normal and the pathologically dilated. The instances of megalogastria are usually discovered by accident and by X-ray because no symptoms are present bringing the individual under clinical observation, and the motor tests are usually normal.

On the other hand, a few instances of very small sized normal stomachs have been noted. The term angustatio ventriculi, however, refers more particularly to the stomach, which, because of esophageal or cardiac stenosis, has not received bulk enough of food at each meal over a considerable time to have it maintain its regular size, or because of severe contracted change in the walls of the organ (diffuse hard cancer, cirrhotic gastritis) has caused a diminution in its size. Of the cirrhotic type described by the French a perfect example is shown elsewhere. Extragastric tumors pressing upon the stomach could cause a relative diminution in the size of the cavity of the organ, and the most common of these are the instances of very large spleen pressing upon the fundic end, omental or pancreatic growths, and gas pressure on a prolapsed stomach by the splenic end of the colon.

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Because of its seriousness, tetany is worthy of special mention. Although the condition is usually a symptom of gastrectasis (gen-

erally following old scarred ulcers), still, it may occur without any such complication—in fact, with no assignable pathological cause of any kind.

Attention was first drawn to tetany by Morgagni, and it was first described in clinical detail by Newman in 1861. Since that time a number of cases have been reported, and numerous theories as to the cause of the symptoms have been advanced. The majority of authors adhere to the intoxication theory and regard tetany as the consequence of an intoxication of the organism with abnormal products of metabolism from the diseased gastro-intestinal canal; as to this, the theory of Martin<sup>2</sup> (and also Gerhardt) that the condition is probably induced by the absorption of some soluble poison which is unneutralized in the stomach is interesting. Kussmaul regarded it as due to dehydration of the tissues, particularly the nerves and muscles, on the analogy of the occurrence of cramps in Asiatic cholera; this belief, however, does not seem warrantable. Germain Séé held to the theory of reflex action from stimulation of the sensory nerves of the stomach, a not unreasonable theory when one considers that tetanic seizures may be precipitated by lavage, be present in cases of severe vomiting, and in intestinal parasites, and particularly that the twitchings may stop when lavaging is discontinued, vomiting controlled, or the parasites have been removed. However, it is most probable in the adult cases that the theory of Bouveret and Devic<sup>3</sup> of auto-intoxication from prolonged action of abnormal processes of digestion is the most reasonable one. The main reasons for this are the isolation of a substance resembling peptotoxin which when injected into animals causes general convulsions, the fact that acetone is commonly found in the stomachs of these patients, and also the presence of increased quantities of indican in the urine.

#### SYMPTOMS AND DIAGNOSIS.

This peculiar symptom-complex is caused by the hyperirritability of certain peripheral nerves, usually the facial and those which innervate the extensors of the extremities. All degrees of seizures are noted from slight facial twitchings, intermittent tonic muscular spasms of the hands and arms or feet and legs, to severe types of convulsions with unconsciousness. The contractures may involve only the neck or calf muscles, and in severe cases are always quite painful. The spasms are generally bilateral, and when well marked begin in the fingers and toes, and advancing to the flexor muscles (the extensors only slightly) bend the elbows and knees. The onset of the convolution is usually sudden, beginning with sensory disturbances in the

hands and feet which are soon followed by spasms of the distal flexor muscles extending rapidly to the muscles of the extremities of the body. The slightest convulsive phenomena are those of creeping numbness, formication, and slight tonic contractions, located particularly in the hand or face. Slight symptoms may be present for a long time without classical convulsions, or they may immediately precede a typical attack of generalized convulsion. The pathognomonic sign of tetany convulsions, which differentiates it from convulsions due to other causes, is the fact that some of them can be reproduced by mechanical or electrical stimulus during the interval between the attacks. The mechanical superirritability of the facial nerve is evidenced by contraction of the muscles supplied by the individual branch of this nerve irritated by tapping. Mechanical irritability of the nerves of the upper extremity is shown by typical contracture of the hand and forearm being produced by constricting the arm. This Brown and Engelbach attribute to venous congestion since they noted that it came on slowly. The duration of the attacks varies from five minutes to several hours, and when prolonged may terminate in death. The fatal cases are those in which the muscles of the larynx and tongue are involved with those of the general body.

Fortunately, tetany is not among the frequent sequels of dilatation, and its presence when pyloric stenosis exists rather argues against malignant disease, although it has been noted in cancer in which there was an absence of HCl secretion and high degrees of lactic acid fermentation present. Usually, however, the stomach analysis shows large amounts of hydrochloric acid together with marked degrees of stagnation and accumulation of foods and fluids—pyloric stenosis of the benign type—this is the form in which acetone and sulphurated hydrogen may be found in the gastric contents. The diagnosis usually lies between epileptiform attacks and the habit spasms.

The prognosis of tetany is always grave, the cases collected by Bouveret and Devic showing a mortality of 70 per cent. and those mentioned by Albu 31 deaths in 40 cases. The prognosis in those who have successfully passed through attacks must be guarded, because the seizures are liable to recur even after lapses of time. According to Brown and Engelbach, the mortality under medical treatment has been 88 per cent.; but since the introduction of surgical treatment, it has been reduced to 37.5 per cent. The prognosis of the individual cases necessarily depends upon the nature of the lesions producing the obstruction of the pylorus, and in these cases most all of them are benign.

**TREATMENT.**

The one efficacious method of treatment is the surgical one and the performance of a gastro-enterostomy for the purpose of providing better drainage of the stomach. Manifestly, in dealing with so serious a condition and one which is always liable to return unless this drainage had been established, the patient's chances for life and comfort are very much better after operation than when temporizing with medical measures. I believe that in all cases surgery should have first consideration, because the number in which a severe pathological condition of the stomach is not encountered is exceedingly small and should not be considered in making a decision as to the desirable method of treatment to institute, namely, medical or surgical. In the light cases when the stomach does not show evidences of dilatation and stagnation the medical treatment by careful dieting and lavage may be tried for a short time, but surgical exploration should not be delayed too long. During the seizures the bromides or chloral by rectum or possibly morphine hypodermically may be employed, and when the convulsions are intense chloroform by inhalation may control the epileptiform attacks for the time being until operation can be performed. Chvostek lays stress on profuse rinsing of the stomach, stopping feeding by mouth, and copious saline infusions as first indications in medical treatment. Should the stomach-tube be used, it should be introduced very cautiously or the manipulations may aggravate the spasms. Rest in bed, equable warmth, tepid baths, and sweating procedures are good supplemental measures. The intravenous administration of calcium lactate may control the spasms.

**REFERENCES.**

- <sup>1</sup> KOPLIK: American Journal of the Medical Sciences, July, 1908
- <sup>2</sup> MARTIN: Osler's "Modern Medicine," vol. v, p. 291.
- <sup>3</sup> BOUVERET and DEVIC: Revue de méd., 1892, p. 38.

## CHAPTER XXVI.

### Splanchnoptosis.

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#### PRELIMINARY REMARKS.

ALTHOUGH Aberle, Rollet and Oppoltzer presented views of splanchnoptosis, J. B. Morgagni (Italian, 1682-1771) was among the first to describe the anatomy of this disorder. Virchow<sup>1</sup> drew definite attention to the dislocation of viscera by peritonitis and to assign various digestive symptoms to them, but it remained for Frantz Glenard, thirty-two years afterward, in his admirable work "Des Ptoses Viscerales Diagnostie et Nosographie (enderoptosie-hepatisme)," to present the subject as a clinical entity of the scope and importance that it deserved. Since that publication numerous clinicians have added to the understanding of the subject, among the most notable of whom were Kussmaul, who drew definite attention to gastrophtosis; Landau, whose interesting works, "Wander Niere" (wandering kidney) and "Wander Leber" (wandering liver), and the writings on the post-puerperal types of splanchnoptosis added much to the practical side of the subject, and also Czerny, Keher, Martin, Schröder, Stiller, Ewald, Kuttner, Fleiner, Curschinaun, Kelling, Meinert, Langerhans, Strauss and others.

Beginning about twenty years ago the medical profession became cognizant of the frequency of these conditions. Before that time displacement of the viscera was regarded as a rarity, displacement of the colon was looked upon as unimportant, and displacements of the kidneys were more particularly mentioned by anatomists than by clinicians. Glenard did most to promote the clinical recognition of the changes of organ position as pathological conditions and to associate constitutional symptoms, such as nervousness, general debility, anemia, etc., with the disorder: thus it was that the term "Glenard's disease" was given to the disorder, an honorary term to which that author is justly entitled.

**PATHOLOGICAL RELATIONS AND CLASSIFICATION OF THE  
VARIOUS TYPES OF ABDOMINAL ORGAN.**

**PROLAPSE AND ETIOLOGY.**

Splanchnoptosis is the better term to employ for the condition since such indicates the ptosis (falling) of the thoracic and abdominal viscera as a whole, because the picture of more than one organ involved is the rule in by far the majority of cases, and also because reference is then made to the relaxation of the diaphragm and abdominal walls in the clinical make-up of the disorder. Gastrophtosis and atonia gastrica signify more particularly the abdominal ptosis (not merely the stomach), while enteroptosis pertains to the prolapse of the enteron (duodenum, jejunum, ileum, and colon). Other terms that are used to designate the special organs that are mainly involved are coloptosis (entire colon), coloptosis dextra, transversa, sinister, sigmoidea (right, transverse and left portions of the colon, and sigmoid), hepatoptosis (liver), splenoptosis (spleen), and nephroptosis (kidney). Although in most cases the term splanchnoptosis answers the best purpose, when apparently only one organ is involved or is descended markedly while the rest are in fairly normal position the term qualifying the single organ may be used.

Before entering into the discussion of the etiology and pathology of splanchnoptosis it will be advisable to call attention to the anatomy and embryology of the abdominal organs. The viscera of the body are held in their respective positions by a number of different forces, namely, the negative pressure of the thoracic cavity acting through the diaphragm and limited by the capacity confines which are made up by the structures entering into the formation of the cavities, by special ligamentous, nerve, vessel and peritoneal attachments, by the visceral pressure of other abdominal organs, the visceral shelves and most particularly by the muscular, fascial, and osseous make-up of the abdominal walls assisted by atmospheric pressure exerted from without. Physiologically, no organ is absolutely fixed, but is capable of a degree of mobility to make possible the changes necessary in function and position, such as physiological congestion incident to secretion and accumulation (glandulature of the gastro-enteron, pancreas, liver, gall-bladder during digestion, the bulk of ingestion of foods and incidental gas formation, secretion and collection of urine by the kidneys and bladder, collection and passage of feces, the respiratory and circulatory movements and pregnancy); the only fixed area within the abdomen being the radix mesenterica. The mobility of the organs is further influenced by the additional factors of attitude

(prone or erect), respiration, muscular movement of the viscera (rhythm), condition of the abdominal wall and gestation.

The positions of the abdominal organs may be briefly given as follows: The stomach lies in the left hypochondriac and epigastric regions, its cardiac orifice being situated behind the seventh left costal cartilage, while the pyloric orifice is slightly to the right of the median line (organ empty) 8 to 10 centimeters (3 to 4 inches) below the xiphosternal articulation; the lowest point of the greater curvature is usually above the transverse umbilical line, and because of the overhanging left lobe of the liver the lesser curvature is not accessible to palpation or percussion. The spleen lies high and deep in the left hypochondrium, can be mapped out by percussion over the lower back and side of the thoracic region with its poles following the course of the ribs, but the organ (unless enlarged or prolapsed) is not accessible to palpation in the abdomen. The liver occupies the whole of the diaphragm on the right as well as a part of the left side, and for the most part lies under the ribs; its upper limit, according to the position of the dome of the diaphragm, varies between the third and sixth costal cartilages, although usually reaching to the fifth chondrosternal articulation in the mammillary line; its lower limits, because of being covered by the lower ribs and in the epigastric region (where exposed) and because of its shelving shape and softness, is not palpable although percussible; when the organ is enlarged or prolapsed, and particularly when firmer than normal, the lower limits of the organ may be felt, but when only prolapsed it may not be palpable and is even percussible with difficulty; the location of the lower margin, however, may be visible by a rise and fall of an irregular oblique sulcus corresponding to the anterior margin. The transverse colon passes across the upper part of the umbilical region closely to and below the greater curvature of the stomach; the splenic flexure reaches a higher level than the hepatic and is behind the stomach; the hepatic flexure also is not accessible to external examination (unless it is markedly prolapsed) and the liver is in place or high above it. The kidneys are situated at the back of the abdominal cavity in the epigastric and hypochondriac regions, the right kidney lower than the left and extending slightly into the umbilical and lumbar regions. The pancreas is situated from 6 to 13 centimeters (2½ to 5 inches) above the umbilicus on a level with the first and second lumbar vertebræ, and, unless organically diseased, is not palpable.

The embryology of the abdominal viscera is a source of interest for the reason that a number of authors regard splanchnoptosis as a reversion of the abdominal organs to the embryonic type. In the

embryo the tractus intestinalis is a straight tube extending from the mouth to the anus, with the liver, spleen and pancreas occupying a central position. At the sixth month of fetal life the small curvature of the stomach extends perpendicularly up and down, the ascending and transverse colon extends from a straight line diagonally upward from the right inguinal region, and the right kidney is low, with the liver resting upon it. With the progress of months the cecum passes from left to extreme right across the enteron (duodenum), the liver passes from the middle line to the right proximal quadrant of the abdomen, in the adult reaching to the dome of the diaphragm (at birth most of the large volume of the abdomen is due to the bulk of liver that is low in the abdomen). Thus it is seen that with the low and central positions of the organs in splanchnoptosis, its resemblance to organ situation in embryonic life is worthy of some thought in the consideration of the etiology of prolapse.

The pathogenesis of splanchnoptosis may be classed under the headings of (*a*) congenital constitutional predisposition in which is included the reversion to embryonic conditions; (*b*) acquired defects producing or encouraging the institution of splanchnoptosis; and (*c*) the combined factors (congenital and acquired) which no doubt make up the most practical aspect of the disorder as a whole in by far the largest number if not in all of the adult cases that are seen. Stiller and Obrastzow regard splanchnoptosis to a certain extent as a sign of degeneration. This, however, assumes the existence of normal persons (parents or offspring) in the first instance, and since I am a firm believer in congenital predisposition being the main single factor of cause in the majority of cases—and consequently such individuals or their parents have not been normal—I think that degeneration as a factor must be considered in about the same light as the unquestionable acquired factors. The imperfect cartilaginous attachment of the tenth rib to the thorax (*costa decima fluctuans*) is merely an evidence of a debilitated nervous, muscular and flaccid ligamentous apparatus as a birth condition and not as a structural degeneration in the proper sense.

A congenital predisposition to prolapse of the internal viscera is seen in the characteristic body form and fragility of tissue and debility of nervous energy noted in those individuals in whom these are always existant in the individual all the way from infancy to the grave. A close observation of infants and children has proven to me that the elements of splanchnoptosis are exceedingly common in the young, and the modes of life, methods of feeding, illnesses of infancy and childhood, etc., are conditions causing the continuation of the condition

or its liability as extra factors. In the light of the judgment that is given to us and the observations that we daily have in the practice of medicine, is it not more logical to suppose that splanchnoptotic conditions or tendencies date usually from the prenatal or early postnatal days of life? Robust parents give birth to the largest proportion of robust children, and the progeny of wealthy parents (who have lived along hygienic lines themselves) and whose children when they become adults give birth to children make up the second largest proportion. The parents who give birth to children during the years of the stern competition of life in quest of affluence or those with improper habits rear almost as many neurasthenics among their offspring as those who are always more or less poverty stricken and are thus compelled to live under unfavorable hygienic conditions with consequent bad constitutional results. Primarily, splanchnoptosis is a status of debility and a type of chronic neurosis represented in a chronic devitality of the sympathetic system. However pathologically this is produced, it represents to a more or less degree poor tissue soil in early life. Whether this is due solely, as Stiller has suggested, to only embryonic defect (*vitium primæ formationis*), or to the physical tribulations of the infant and child, or only to acquired conditions in late life will always remain a problem and different in each adult case that is seen.

The children that are born of poorly nourished parents, or those in whom tuberculosis, syphilis, alcoholism, or chronic disease or states of debility are present, have the largest number of offspring of the poorest quality. Added to these are the mysteriously wrought effects on children of neurasthenic and neurotic parents. Then come such conditions as improper feeding of the infant and child, the living of the child under unhygienic conditions for complete continued health, rachitis with its damaging effects on the nervous, muscular, osseous and ligamentous tissues, more or less mild and unrecognizable states of scurvy and the infectious diseases of childhood to which the child is especially prone (scarlet fever, diphtheria, measles, enteric conditions, etc.) and the after-treatment of which is not considered of much importance in medicine, but which, nevertheless, often leave a legacy the state and kind of which would cause anxious moments in the grown, but which in the child receive little attention. Now come the schooldays, with their close confinement and too little outdoor play and recreation, followed by the grind in college or life in shops or factories, and then finally the wearing incidents to life in business, homes, and in women the bearing of children and dangers of post-puerperal relaxations of the abdominal parietes. Along these lines many of the adults who apparently were born healthy but who, nevertheless, had anatomical splanchn-

noptosis finally present symptoms which clinically are those associated with visceral prolapse.

The acquired defects producing or further developing splanchnoptosis so that symptoms are developed are: repeated gestations, the sudden loss of fatty tissues or extraction of accumulations of abdominal fluid or removal of large-sized abdominal tumors, the traction o



Fig. 133.—Child of 13 years with splanchnoptosis (gastrophtosis and nephroptosis). Always delicate in health. More or less chronic digestive disturbance since 3 years of age (congenital). Very neurotic. Appetite variable. Bowels constipated. More or less constant distress (she says "pains") in abdomen, at times becoming worse and running in periods of three or four months. Weight 70 pounds. Photograph shows the long thorax-abdominal type in which prolapse is commonly present; also the poor development for a child of her age, and the position of the stomach (two-thirds of the right kidney also palpable). On the stomach outline is the site of the cardiac orifice; X, heart apex.

adhesions attached to the movable viscera, the influence of viscere motion in respiration from conditions in the thoracic cavity, the effects of living and dressing (waist-constricting bands), as well as t various industries. Of these, it may be said that, clinically, t

anemias and toxemias, the more chronic forms of infectious diseases, faulty breathing, disease of the thoracic organs, with general debility from improper living, the waist constrictions, and gestations make up the greatest bulk of factors.

A consideration of the above factors requires first a few words on the anatomy and physiology of the abdominal walls. The musculo-fascial structure of the abdominal parietes is attached to the fixed bony parts of the costal, iliac and pubic crests as well as to the vertebral column, with its vault (diaphragm) also centrally fixed by the pericardium. The muscular structure consists of oblique, perpendicular and transverse layers snugly held in a compact make-up by the fascial bands and muscle sheaths so as to form a powerfully elastic, and, when contracted, an inelastic wall. Its physiological action, a combined one, is that of a flat circular band for the purpose of negatively (without the necessity of contraction) supporting the abdominal viscera; Robinson had shown that, with the abdominal walls cut away and the body in an erect position, the neurovascular visceral pedicles do not support the organs, but only limit the degree of descent. The main muscles which preserve the visceral poise are the two recti and in well-marked splanchnoptosis these are often elongated from stretching, with thinning, separation, and atrophy of the fibers, permitting, as must be evident, of elongation of the muscles as a whole and separation at the linea alba, the linea semilunares and the linea transversæ. With the muscular condition affecting also the lateral planes, the fascial structure loses its tone and becomes relaxed. The inherent weakness of the musculofascial walls from states of general sub-nutrition allowing devitalization of tissue, such as may be seen in the anemic, poorly nourished, alcoholic, neurasthenic and subjects of infectious disease (tuberculosis, typhoid, and other infectious diseases long enough continued), permits of first a loss of the proper visceral support and then an actual increase in the size of the abdominal cavity as the internal organs fall to the lower levels, causing a forward pressure. The skin and peritoneum, very elastic structures, distend, they in themselves by virtue of structural make-up not being able to sustain the organs when once the musculofascial walls are impaired.

Added to the loss of tone are the distending or vis a tergo pressures that are physiologically exerted more or less constantly, according to conditions. There is then the distention and the contraction in respiration, the accumulation of ingesta, gases and feces, and the act of defecation, the process of gestation with its rapid distention of the abdominal walls terminated by severe contraction in labor and always followed by a more or less permanent physiological relaxation of the

walls, and the act of laughing, coughing, etc., which also bring the abdominal muscles into play. Such pathological conditions in the chest as emphysema, pleural effusions of the pneumo-, hydro- or pyogenic forms increase the cavity of the thorax, depress the diaphragm, and thus cause quick accommodating relaxation of the abdominal walls with descent of the abdominal organs. Ascites or large-sized abdominal tumors (conditions that usually exist long enough to more or less permanently distend the abdominal walls) on removal are followed by more or less visceral descent in about the same way as a pregnancy. Whenever there has been a rapid loss of weight for any reason, the absorption of intra-abdominal fat, with the concomitant devitality or loss of tone in the walls caused by the disease, encourages descent.

The factor of waist constrictions is a most interesting one, and one which is important in a few of the instances, but by no means a prominent one in the majority of cases. Diverse opinions on this exist, Einhorn believing that waist-constricting bands (corsets) play an important rôle, and Fuhs, a stern believer in the costal stigma, arguing that the frequency of splanchnoptosis among unmarried Swedish girls who have never worn corsets disproves this statement; it has also been shown that Arab women, who wear no constricting articles of clothing, are frequent sufferers from the condition. There is no doubt that, in women who have worn the formerly fashionable small-waist corset, the confining dimensions and the interference with proper diaphragmatic descent essential to abdominal breathing cause pressure upon the liver and thus the resulting descent of the pyloric region of the stomach, the hepatic flexure of the colon, and the right kidney. Still, this type of corset is not commonly worn nowadays, and the great majority of women have learned of the bad effects coming from that type of garment and tight lacing, and thus dress accordingly. The popularly called "straight-front corset," now generally worn, which is low in the bust and coming down over the hips for purchase, is really a hygienic garment and one from which but little if any harm can come. It occurs to the writer that just because a woman wears a corset (unless this corset is of the first-mentioned type) we can hardly blame the corset for being responsible for the condition of prolapse. In my opinion, it seems wiser to assume an indifference in this respect with the modern, properly built corset, but that with the older styles of waist-compression garment a condition of splanchnoptosis existed before the corset-wearing days which had probably been made worse by them. The examination of many children (both male and female) who have no symptoms of digestive disturbance as well as full-grown adults will show that more or less splanchnoptosis is a common finding. The majority of these go on in life

never being aware of the condition; in fact, not having digestive disorder without assignable cause any oftener than those in whom the organs are in physiological position. But when in conditions of debility and other causes the element of constant waist compression is added, symptoms can develop, and in this way the old style of corset may be looked upon rather as a late added but not altogether responsible causative factor.

That splanchnoptosis can develop and most certainly becomes worse from gestations there is absolutely no doubt. Landau was the first to draw pointed attention to this, since which time the eponym, "Landau's splanchnoptosis," came into common usage. Landau believes that the primary cause of all cases of splanchnoptosis is a weakness of the abdominal wall, in many cases congenital, but oftentimes acquired. Riegel also firmly believed that the condition was for the most part acquired, and avers that pregnancy and parturition and the removal of tumors and ascitic fluids (which latter may be regarded as in the same causative relation as gestation) are responsible. Almost daily in clinics in which a large number of digestive disorders are handled is obtained the history of perfect health up to the time of the birth of an infant, and a history of visceral abdominal and neurasthenic affections dating sharply from the parturient days. Sometimes it is after the first labor and in another case it dates from one of the subsequent pregnancies, the individual having been well up to the time of that particular gestation. Examination of some of these mothers usually shows a pitiful state of affairs in so far as the abdominal wall is concerned. There is observed a large, lax, and atonic structure involving all of the component tissues, even the external integument, having a wide path of separation of the recti, with a pedunculous and bulging abdomen in the erect position and one that bulges at the flanks in the prone.

A most valuable contribution to the pathogenesis of splanchnoptosis is that of Keith,<sup>2</sup> who believes that the condition is the result of a vitiated method of respiration. According to this author, the organs within the thoracic and abdominal cavities are poised between the two contending sets of muscles of inspiration and expiration, and it is pointed out that, although cases appear with only one organ affected, all of them share in the condition to a greater or lesser extent. Before the displacement can be produced, either what he terms the thoracic supports of the diaphragm must have yielded or the antagonistic abdominal muscles must have been hampered or weakened in their action (for example, tight corsets), the bands which fix the viscera to the abdominal walls being looked upon as of subsidiary importance.

With the loss of tone in the abdominal walls is a shortage in the intra-abdominal pressure. In the normal human being and all of the vertebrate animals, the pressure within the abdominal cavity is dependent upon the contraction of the diaphragm, and the tone and the active contraction of the abdominal parietal muscles, including the pelvic floor, acting from relatively fixed points of the thorax, pelvis, and vertebral column. Whatever diminishes the tone of the diaphragm and the abdominal muscles causes a fall in the positive abdominal pressure. If at the same time the thoracic expansion is active, there will be a fall of abdominal pressure below atmospheric pressure. If at any time the tone or activity of the diaphragm and the abdominal muscles is increased, whether the thoracic expansion is diminished or normal, the abdominal pressure will rise above its usual positive points (Emerson). It is thus apparent that the neuromuscular mechanism that maintains this pressure is balanced to an extent by the conditions within the thorax, and this explains how, in the circulatory emergencies in infectious diseases, meteorism, abdominal distention, and interference with the descent of the diaphragm may cause cardiac failure, and the dyspneic and asthmatic symptoms that accompany many of the gastrointestinal conditions, although these are rarely seen in true states of splanchnoptosis. The intra-abdominal pressure is always below normal in splanchnoptosis, though in advanced cases not enough above atmospheric pressure to record it on the most sensitive apparatus that can safely be used for the purpose. The normal pressure within the abdomen varies from zero to + 3 cm. of water. My observation in a number of cases has been that, as improvement from treatment takes place, the positive pressures within the colon, sigmoid, rectum, and stomach are higher than before.

Other factors entering into the production or accentuation of the condition are: lordosis or anterior curvature of the spine; deficient intake of food, putrefactive disease in the colon, excessive labor, and peritoneal and omental adhesions. Of the latter, Robinson<sup>3</sup> has called attention to peritoneal adhesions induced by trauma and also no doubt by inherent disease for other reasons in such conditions as appendicitis, cholecystitis, sigmoiditis and salpingitis, all of which form visceral masses so that the several viscera cannot glide on each other. According to this author, the solid visceral masses act like a piston in the abdomen forcing the viscera distalward. It is more probable that the evil effects are produced more by traction upon the hollow viscera and immobility, both being due to fixed position.

On the subject of fatigue affecting gastric motility, an important subject in the production and cure of ptosis, the following are important: The movements of the alimentary tract are regulated not only by local

nerve centers in the walls of the canal itself, but also through impulses which arrive from the central nervous system. In this way many influences which may even in part be conflicting in their effect can play on the gastro-intestinal tract at the same time. With the possibility of disturbing influences coming to portions of the intestine either reflexly through the central nervous mechanism or from other parts of the digestive apparatus, it is not surprising that discrepancies have arisen in regard to the interpretation of the motor phenomena. Observations of the gastro-intestinal motility by means of Roentgen examinations, which leave the organism intact and are applicable even to man, have a decided advantage, therefore, whenever it is desired to consider the general effect of any condition on this function. This lends a special value to Kast's recent study of the effect of fatigue on gastro-intestinal movement.<sup>3a</sup> Fifty-four individuals were kept on a standard diet for a number of days, and the motor efficiency of the stomach and intestines was determined repeatedly by a combination of the Roentgen method, the use of the stomach tube, and the administration of carmin to determine the period of transit of food residues through the bowel. By taking the average, it was determined how long it took the stomach, and separately, how long it took the intestines, to propel the given amount of food. During the period of tests, the amount of physical activity was markedly increased or decreased, and the effect on the evacuating power of the stomach or intestines observed. At other times, without change in the diet or the amount of physical exercise, the amount of mental effort was markedly increased or decreased, and the effect observed in the same manner. Summarizing the results of such experiments, it appears that the healthy individual showed very little variation as regards the evacuating power of the stomach or intestines as long as the physical exercise was not excessive. Mental efforts had no perceptible effect. In patients with moderate and marked degrees of atony and splanchnoptosis, the evacuating power of the stomach and intestines decreased in direct proportion to the amount of mental and physical exertion. Physical exertion had the same effect in such individuals if the patient was kept in a horizontal position during these exercises and during the period of observation in order to eliminate the effect of splanchnoptosis in the erect position. In patients who clinically appeared susceptible to the effects of fatigue, mental exertion was more marked in its delaying effect than physical exertion.

#### FREQUENCY AND PATHOLOGY.

In discussing the frequency of splanchnoptosis it is evident that the statistics must be general in regard to the organs involved. Because,

as was stated before, the descent of only single organs so rarely covers the full condition met with in the cases it must be taken that figures representing gastrophtosis or nephroptosis must nevertheless be taken as those of splanchnoptosis in the more general sense.

Glenard at the Vichy resort found that 147 cases of splanchnoptosis existed in 1310 subjects—11 per cent. Einhorn saw 70 cases among 1080 males ( $6\frac{1}{2}$  per cent.), and 277 cases among 832 females ( $33\frac{1}{3}$  per cent.). In (1909) the first 150 cases of digestive disorder in the author's clinic, distinct conditions of splanchnoptosis with symptoms referable to conditions of organ prolapse were encountered in 31 (5.1 per cent.). Of these 6 were in males and 25 were in females. In addition to this, more or less descent of the various abdominal organs (stomach, kidney, liver, colon) were noted in 23 more, but the diagnosis of other conditions was so much more evident that the prolapse was not considered as the causative condition. Altogether then, in males and females, there were 54 instances of prolapse in the 150 cases of all conditions, about 33 per cent. Arneill found records of splanchnoptosis in 11 men and 69 women in 2004 cases, but these figures in my experience are much too low for clinics where the poor are handled, and to a lesser extent for private practice with those who are better nourished and who take better care of their health. During the year 1909 I saw in my clinic and office gastro-intestinal and metabolic conditions numbering 1924, and of these there were 501 instances of states of visceral prolapse with the neurotic syndrome accompaniment, a percentage of about 26.

As regards the special organs that are mainly involved, reports of gastrophtosis from various sources vary markedly as to its frequency. According to Meinhert,<sup>4</sup> in Dresden, the majority of women have a displacement of the stomach, while only 5 per cent. of the men show an alteration in the position of that organ. Among 2000 patients at a Stuttgart polyclinic who presented themselves on account of various ailments not connected with disease of the stomach, the condition was noted in 29.7 per cent. of men and 75.4 per cent. of women. Many differences of opinion exist among the various observers as to what constitutes gastrophtosis, for what would represent a definitely low stomach to one, by another may be considered as the normal position. Since the advent of the X-rays in the diagnosis of gastric affections it can be observed that the long, attenuated, and apparently prolapsed stomach is a most common occurrence in women, so common, in fact, that the author feels that, as compared to the shape of the organ in the average male, the stomach in the female is physiologically more on the gastrophtotic order without its really being prolapsed. This is due in

the female to the relatively smaller sized waist and large pelvic capacities, the influence of pregnancy, the more relative frequency of flaccidity and poor muscular development of the abdominal walls, and the wearing of corsets or heavy skirts hanging on the waist bands (all of which are also considered as required factors to true gastrophtosis).

An analogy to the latter mentioned is seen in males who wear belts, for of 172 men with gastrophtosis mentioned by Hirschfeld<sup>5</sup> 72 wore narrow belts around the waist, while among 406 men with a normal position of the stomach only 16 used the belt, the remainder employing suspenders.

Although the term gastrophtosis signifies abdominal relaxation, to be definite, the term will here be used as referring particularly to the low-hanging stomach, which, as was mentioned before, is usually only a part of the complex organ involvement in splanchnoptosis. According to both Rose and Robinson, gastrophtosis (atonic gastritis) practically includes the terms of dilatation of the stomach, gastrectasia, gastric insufficiency, motor insufficiency, ischochymia (retention of chyme), myasthenia, etc., because it signifies abdominal relaxation and relaxation includes dilatation and motor insufficiency. My own belief is that those authors in an effort to simplify the nomenclature on these subjects have lost sight of the fact that there are other gastric conditions than prolapse which can cause myasthenia, atony, dilatation and stagnation, and that the trend of their writings is to further confuse the entire matter rather than clarify it. A gastrophtosis is what its name is generally accepted to imply; the other terms are resulting conditions in some of the cases of gastrophtosis but not in all, nor does "ataxia gastrica" cover the other pathological conditions of the stomach in which these same conditions are also secondary.

The shape of the stomach in gastrophtosis comprises a wide variety, depending upon the degree of descent, the attenuation of the walls, or extent of atony which usually is more or less present. From the cardia to the point of the duodenum that is fixed to the spinal column (at the outer extremity of the first 2.5 centimeters or 1 inch of the duodenum), the organ and duodenum are surrounded by peritoneum. It will thus be seen that the pylorus itself is movable, although from the close proximity of the fixed point of the duodenum the radius here is small as compared to the body of the stomach. Therefore, the extent of sagging of this part of the digestive canal is in that portion between these two fixed points. As the lesser omentum lengthens, the stomach reaches to a lower level by swinging toward the left lateral confines of the abdominal cavity, the pylorus itself also dropping to a lower plane. To the extent of attenuation of the walls (the length from

cardia to pylorus), the vertical diameter of the organ in the intermediate section reaches lower and lower until finally the so-called "looped," "fishhook," or "drain-trap" stomach is produced. In marked instances, the greater curvature (which normally ascribes an inverted arch from about the tip of the left ninth costal cartilage to above the umbilicus in the male and to about its level or slightly below in the female) sinks to the left lateral confine of the abdomen until all but about the pyloric region is very nearly straight up and down. In such an instance, as Pfahler has shown, the stomach still remains in full volume throughout its course, and the kinking or obstruction commonly present in such a case is not at the pylorus, as was formerly supposed, but occurs at the point of duodenal attachment to the spine. From Robinson's writings and observations it also seems reasonable to believe that, in cases of marked enteroptosis when the coils of the enteron lie in the pelvis, the traction and depression of the mesentery could cause the superior mesenteric artery, vein, and nerve (which pass in front of the transverse portions of the duodenum) to press upon the duodenum, cause a constriction and the development of a secondary gastroduodenal dilatation. But there is little doubt in my mind that, in the average case of splanchnoptosis seen, the latter is not so frequent a cause for the dilatation of the stomach as are the atonies of the organ consequent to long-standing gastric disturbance.

Of the incidence of nephroptosis, Ebstein found movable kidney in 5 of 3658 post mortems, while Landau reports only 4 cases among 6999 hospital patients. That these numbers are much too low is proven by those of Mathieu (85 in 306), Larrabee (112 in 272), Glenard (481 in 3788, 2.7 per cent. in men and 22 per cent. in women). Burnam (1 in every 5 women and 1 in every 50 men in the Johns Hopkins Hospital), and Kuttner (in 667 cases collected from the literature and his own practice there were 584 women and 83 men, a proportion of 1 male to 7 females). As regards age, displaced kidney may be met with in very young subjects, even under three years. More are encountered between the ages of three and ten years; in Kuttner's series of 326 cases, 32 were between ten and twenty years, 82 between twenty and thirty, 123 between thirty and forty, 49 between forty and fifty, 26 between fifty and sixty, and 8 between sixty and seventy. It will thus be noted that the greatest proportion is met with in those in the middle decades of life. As to race, Larrabee's series of 112 cases in 273 patients shows the condition to have been found in Americans in 37 per cent., in Irish 51 per cent., in British 49 per cent. and Russian Jews in 30 per cent. According to Kuttner's series on the relation of pregnancy to nephroptosis, of 94 cases, 40 had

never borne children, and 10 had borne two or more children. In Landau's series, 31 of 34 had borne no children. In Larrabee's series of 112 cases, 51 were nulliparous and 50 multiparous. The frequency with which the right, left, or both kidneys were involved was, in Kuttner's series of 727 cases, 553 the right kidney alone, 81 the left kidney alone, and in 93 both kidneys. In Einhorn's series the right alone in 77.3 per cent., the left alone in 2.1 per cent. and both kidneys in 20.6 per cent. These latter figures also correspond with those of my own.

Ventral to the right kidney are the liver, duodenum, colon, and enteron; and ventral to the left kidney are the stomach, spleen, colon, and enteron. The perirenal areolar tissue binds the adipose capsule of the kidneys to the diaphragm, and on the right side this is further attached by its fusion with the meshepaticon, and on the left side with the suspensory ligament of the spleen and coronary ligament. This, with the indirect visceral pressure, structure of the diaphragm and abdominal wall are the main physiological supports to the kidneys, which organs have no visceral shelves and lie in shallow fosses. On the occasion of descent, however, the renal pedicle, composed of the renal artery, vein, nerve plexus, lymphatics and fibrous sheath from the radix mesenterica, limits the degree of descent. The kidneys are depressed on the contraction of the diaphragm, and thus rise and fall with respiration. But when either of them has descended to a permanently lower position than normal, the close association with the diaphragm is lost, and the up-and-down movement with respiration does not appreciably exist. This is always plainly evident on examination of a floating kidney, and such movement as may exist on respiration is only indirectly exerted upon the kidney from the other abdominal organs.

It must also here be added that the main if not the only definite subjective symptom of nephroptosis (Dietl's crisis) is due to a rotary twist of the renal pedicle, and not to a distal or proximal movement causing tension of it. Slight or moderate degree of descent of these organs is a symptomless condition, and, in fact, by some authors, is not considered as an abnormal condition at all. Robinson in some 700 autopsies claimed that in general the distal pole of the kidney extends to the fourth lumbar vertebra, and noted, in the examination of 620 cadavers (men 465, women 155), that the general average was, that the right kidney was one finger ( $\frac{1}{4}$  inch) proximal to the iliac crest while the left kidney was two fingers ( $\frac{3}{4}$  inch). This observer also noted that the kidneys of women were about  $\frac{1}{2}$  inch more distal than those of men, and in about 15 per cent. of the females the distal right

kidney pole was on a level with the iliac crest. According to these observations, the kidneys are situated lower than was ordinarily supposed, and a palpable kidney is not necessarily pathologically displaced, and, as he suggests, does not sanction surgery to anywhere near the number of instances that these cases had been subjected to.

As regards the degree of displacement, Glenard describes four grades: (1) when the lower pole can be felt only during deep inspiration; (2) when the greater portion of the kidney can be felt but the upper border cannot be made out; (3) when the whole kidney can be palpated during deep inspiration; and (4) when the entire kidney can be palpated and is capable of being moved about the abdominal cavity, this latter being the true floating kidney. Ewald and Kuttner do not consider No. 1 of Glenard as that of displacement, although they substantially accept the other grades. To this it may be added that in a short-waisted person to feel one-third or even two-thirds of the right kidney also may not be pathological, particularly when it moves directly on the excursion of the diaphragm and always at the side of the spine in vertical lines and lies deep in the abdomen.

Displacement of the liver is comparatively rare, providing we mean the descent of the complete organ, although more or less descent is common, particularly in women affected with the Landau type of splanchnoptosis. The reason for complete descent being so uncommon is because the liver is more firmly fixed to the diaphragm than any of the other organs and it is the highest situated organ in the abdomen. But by virtue of its weight, its wide area of extent, and in inspiration pounding upon all of the other abdominal organs, it no doubt is important in the production of general visceral descent or the aggravation of the condition. Among 31 cases of floating liver that Landau collected from the literature, 27 occurred in women and 4 in men. Glenard reports 51 cases of displaced liver, 32 being associated with movable kidney, and, of these, 30 were women and 2 men.

Total displacement of the spleen is still rarer, occurring probably in not more than  $\frac{1}{3}$  per cent. of cases of distinct splanchnoptosis. Glenard reports that he found "wandering spleen" in 2 of 160 cases of enteroptosis. It is probable that the instances of slight and moderate degrees of splenoptosis are more common than have been reported, but because of the inaccessibility of the organ to examination, and the fact that, for obvious reasons, even by the most careful percussion one cannot always be sure that the organ is low, they are liable to escape recognition.

Displacements of the enteron and colon are only second in importance and frequency to gastrophtosis. Of these conditions the dislo-

tion of the transverse portion of the colon producing more or less of a curve with its convexity downward is one of the most frequent factors in splanchnoptosis. At autopsy it is not infrequent to observe the middle of the transverse portion of the colon projecting into the pelvis instead of being in position about on a level with the umbilicus, and X-ray observations of the colon in the living shows this to be the most common. On these occasions the width of the mesocolon, which in the adult is about 11 centimeters ( $4\frac{1}{2}$  inches), may be stretched to from 15 centimeters (6 inches) to 23 centimeters (9 inches) in length. The descent of the liver and right kidney may be such as to force the hepatic flexure downward (coloptosis dextra), in which case the colon from the cecum takes an oblique course to the splenic flexure, which is less rarely prolapsed. It is important to remember that the base of the right mesocolon is fixed to the ventral surface of the right kidney at its lower end, and thus with the descent of the kidney the hepatic flexure must fall. The splenic flexure rarely possesses a mesocolon, and is thus but seldom prolapsed. The sigmoid, however, has a mesentery about 6 centimeters ( $2\frac{1}{2}$  inches) in length, and this portion of the left colon is much more commonly prolapsed and may have a range of mobility reaching even to the spleen, liver, stomach, or cecum. A common finding by X-ray is to see most of the coil of the sigmoid low in the pelvis, and perhaps beginning in its course to the descending colon close to the cecum. The descended hepatic flexure may press downward upon the cecum so that a portion of the lower part of it is below the level of the brim of the pelvis—a positive sign of splanchnoptosis in every instance. The small intestine has the widest of all of the mesenteries, and by virtue of its triangular shape, with a narrow base upward and attached at only one angle, may permit of flexions, stenoses, dilatation, and disturbance in circulation, etc., in the ileum and jejunum.

Downward displacement of the heart (cardioptosis) may also occur when the diaphragm is low and the abdominal walls are sorely deficient. Einhorn found it 22 times in 926 patients, 18 in men, 4 in women, and in about half of the patients there was an associated hepatoptosis. Smithwick found that displacement of the pelvic organs of generation were common in splanchnoptosis, about 80 per cent. of the women having retroversion of the uterus. From the standpoint of the gynecologist this fact is very important, since my experience has been that with some of these women a proper fitting corset is a most necessary adjuvant to the pessary, and may even relieve the pressure upon a not too badly retroversed uterus sufficiently to permit of normal position without the employment of a pessary.

## SYMPTOMS AND DIAGNOSIS.

**General.**—The general or subjective symptoms are those of a neurosis, but in the analysis of a large number of cases of splanchnoptosis and comparing them with the truer neurasthenic affections or the other neurological conditions affecting the abdominal viscera, certain differences are noted. These differences, however, are not distinct in all of the cases, and thus can only be taken as suggestive of the condition—the main diagnostic points being objective in nature in noting the lower organs. A splanchnoptosis may exist without symptoms or change in mobility or secretion, and these never take place unless the nervous compensation is assailed.

The most important feature in this regard is the chronicity of the illness, for splanchnoptosis being a visceral disorder of long standing, there is usually obtained a more or less continuous history of digestive and general neurotic disorder spreading over long periods of time. In neurasthenia proper, a cause such as would be represented in an extra expenditure of nerve or physical forces, or one that would represent a deficient supply of same for any reason, is usually obtainable. When, in such a case, splanchnoptosis is also present, it is then quite difficult to separate the two diagnoses in the way of cause and effect for the reason of the close similarity in factors making possible the production or the aggravation of symptoms in each. But neurasthenia is usually a concrete condition, developed, as the cases are clinically seen, as a result of unhygienic conditions making possible its production. In this way it usually dates from a definite time or period, and differs more or less distinctly from symptoms of a congenital neurotic temperament, although the latter, by predisposing the individual to neurasthenia, may overlap the former so intimately as to make distinction between the two impossible. Therefore, a person developing neurasthenia does not necessarily have or must develop splanchnoptosis, although, on the other hand, a neurotic individual, because of the nervous instability, perversion of nutrition or subnutrition, is, by virtue of the general devitality, prone to both splanchnoptosis and neurasthenia. An argument in favor of the latter may be seen in the Landau type of splanchnoptosis, in which, after the abdominal relaxation and devitalization due to gestation and lactation, the visceral prolapse is more pronounced and the neurasthenic symptoms are secondarily developed from the consequent interference with the proper digestion of food; hence the necessity of the maintenance of an excellent condition of nutrition during gestation, parturition, and lactation. It can also be said that an individual who has had long-standing visceral prolapse without

local or general symptoms can, from causes making possible the production of neurasthenia, develop the latter to a more or less clinical entity separate and apart from splanchnoptosis as a condition requiring primary attention.

To separate the more definite neurological symptoms of splanchnoptosis from neurasthenia is obviously most difficult if not impossible, but in the study of a large number of distinct cases of each as they clinically present themselves there is much suggesting that this is possible. The cardinal difference between the two is, that in splanchn-



Fig. 134.—Edge of the hand sunken into the diastasis of the recti muscles below the umbilicus in a case of Landau splanchnoptosis.

noptosis the symptoms in character and largest numbers refer to the abdomen and the general neurological symptoms are chiefly referred from this region, the more general ones that cannot be associated with the prolapse being grouped as of lesser clinical character. In distinct neurasthenia (without splanchnoptosis) the head and special symptoms are mainly of a primary feature, among which may be mentioned inability to perform ordinary mental work, conditions of mental depression, apprehension and irritability, sense of fullness and throbbing in the head, headache usually occipital, weariness on exertion, pain in the back and tender spots along the spine, pain over the cervical vertebra and sacrum, sexual symptoms, the vasomotor symptoms of heat and cold flashes, localized sweating, transient blueness, tachycardia, painful feel-

ings in the heart, etc. In splanchnoptosis, even when a mild degree of secondary neurasthenia had developed, the subjective symptoms referring to the abdomen and radiating from it are: pain or distress in the epigastrium radiating to the sternum and dorsal region and shoulders, dragging or burning pains in the umbilicus, side, or spinal region below the waist line, those of gastric disturbance manifested after meals, constipation, feeling of lack of abdominal support, nausea and occasional vomiting, rumbling, gurgling and flatulency, abdominal symptoms



Fig. 135.—Clinical case of Landau splanchnoptosis. Mrs. A. M., 28 years old. Family history negative. Personal history good, in so far as digestive organs are concerned. Bowels had always moved daily before labor. Primipara, delivered by midwife December 12, 1906. Labor normal. Child weighed 8 pounds. Bandaged indifferently for one week, not afterward. At her domestic duties on the tenth day. Symptoms of illness came on two months after delivery. Photograph shows the concavity of the abdomen above the umbilicus and the bulging of the lower zones. There was but little contractile and sustaining power in the walls above the navel. Below the navel the contraction was more pronounced. She had very poor control over the musculature of the abdomen. When examined three months after delivery she had marked gastric stagnation with accompanying symptoms. Bowels constipated. Had constant pain in the back and right iliac region; was unable to work, and had to rest on her back most of the time to get relief. She was practically an invalid.

developed or intensified when the individual has been in the erect position for some hours or by walking and their being relieved when the patient has been prone for a time, and frequent micturition from

pressure upon the bladder. To these, of course, are added, to a degree depending upon the extent of general secondary neurasthenia, those enumerated in the first instance.

**Objective Symptoms.**—The objective symptoms of splanchnoptosis are usually those of a thin, pale, young man or woman, slight in build, of the long thorax and abdomen type, with a thin, soft and atonic abdominal wall, and possibly a floating tenth rib. The Landau type is usually better nourished than the nulliparous women, the first being plump in build and may even be quite stout. The one



Fig. 136.—Same case as Fig. 135, showing the degree of descent of the stomach, colon, liver, and right kidney.

distinctive objective feature of these cases, however, is the shape, and then the change of shape of the abdomen in the erect and horizontal positions.

Viewing the lower part of the trunk in profile in the latter-mentioned cases it will be observed that the outline is that of a pendulous abdomen, ascribing a straight or a concave outline from the ensiform to about a transverse level running from the lowest ribs. From there downward begins a sharp convexity forward, rounding out a very low and bulky abdomen that overhangs the mons veneris and groins. With this there is often a lateral bulging, which, from the depression of the midline sulcus, gives to the abdominal prominences an inverted insect-winged

shape when viewed from the front. A relaxed roll of abdominal tissue also runs from a little in front of the anterior superior spines of the ilia, backward level with the crests, to be lost about two-thirds of the way back from the front and back outlines. In the prone position the order is inverted, that is, the anterior abdominal line becomes flat, the umbilicus has raised to a relatively higher position, the anterior edge of the ilia at and below the anterior superior iliac spines becomes prominent, and the greatest degree of bulging is at the sides and flanks, caused by the replaced viscera being in higher planes within the cavity.

On examination of these abdomens it will be noted that the general tone of the structures is impaired, the abdomen being flaccid and capable of being readily pushed about. A more or less degree of separation of the recti (noted best below the umbilicus) will be observed in the pendulant abdomen cases, and on the contraction of the abdominal muscles by the patient (straining as if at stool) it will be noted that the wall has lost its firm and board-like contracting power, seen so generally in the normal. The objective points in the examination of the special organs will be taken up separately. It must be remembered that in women who have not been pregnant and in men the abdomen may be normal in shape, both when standing and lying.

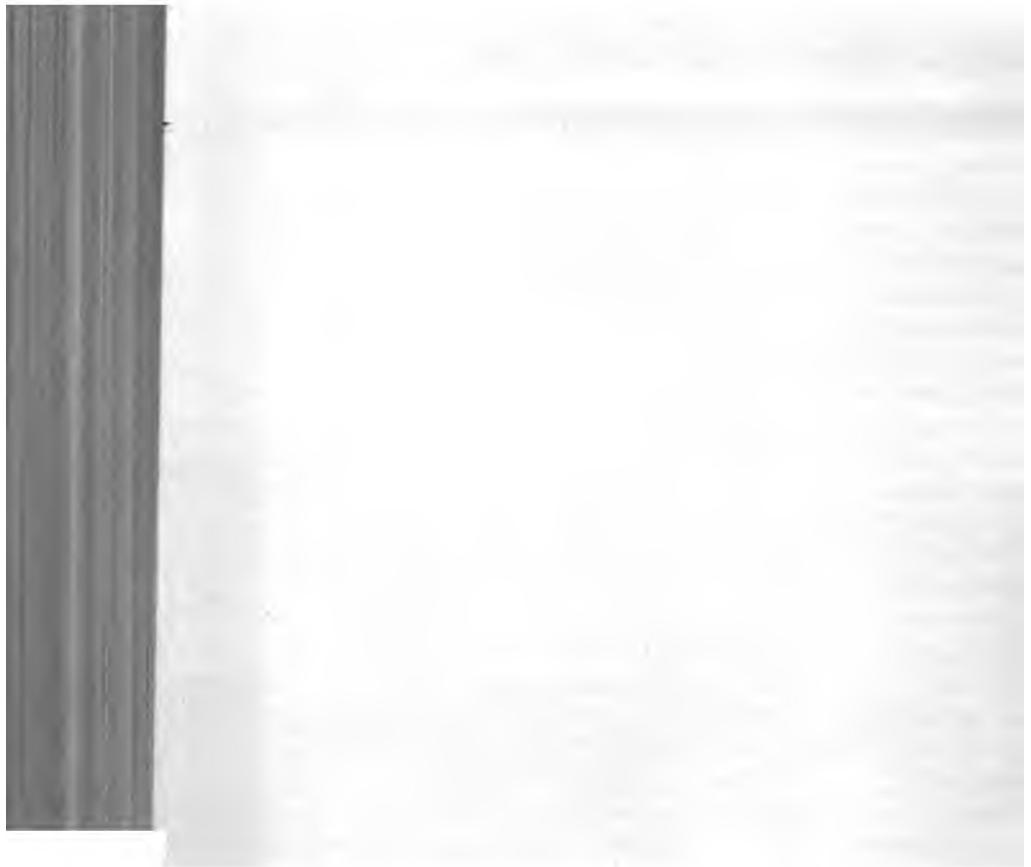
**Gastrophtosis.**—As was stated before, the special objective signs that constitute a prolapsed stomach are to some extent still a matter of personal equation with each observer. In arguing this it must be remembered that the position of the stomach in the erect posture is always lower than that in the prone, and thus it is that percussion of the organ in the prone position may show a normal shape and size of stomach when a gastrophtosis actually exists. Percussion in the standing position is most unreliable, for the reason that whatever fluids the stomach contains sink to the lowest regions (and thus obscures the note), and the gases rise to the inaccessible fundus and lesser curvature regions. It may, however, be said that an inflated, foodless stomach which on percussion corresponds to prolapse of the organ in the prone position is really proptosed, and that when the area that the stomach cavity occupies does not respond in mobility in the changes from the erect, horizontal, and then with the head low and feet high, or on respiration, it is most probably held in a fixed position by perigastric adhesions.

The normal stomach at its upper two-thirds is almost vertical, and the lower one-third is nearly horizontal, the lowest point of the greater curvature being about 2.5 centimeters (1 inch) above the umbilicus in the male, and near to or at the umbilicus in the female. When in the

PLATE LXXXVIII.

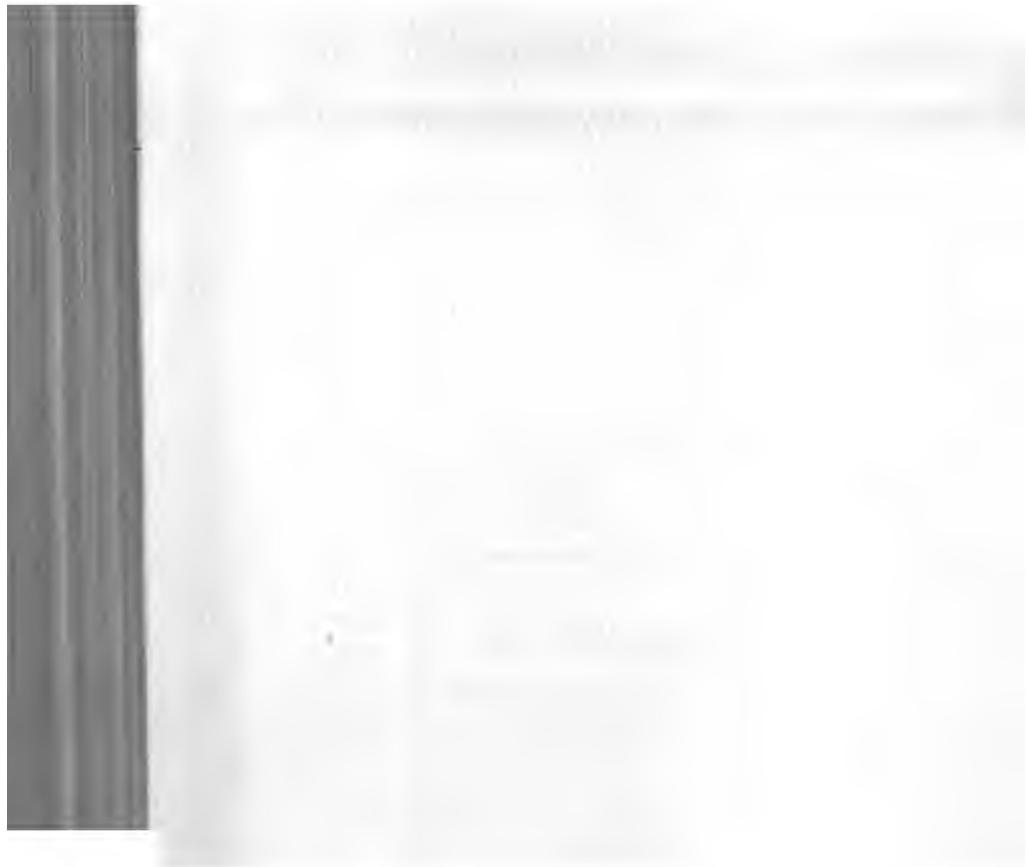


Abdomen in a clinic case of splanchnoptosis. Upper figure shows the profile of the abdomen with its convexity above and its protuberance below in the lower zones of the abdomen. The sag of the abdomen produced the side relaxation shown by the bulging over Poupart's ligament. The lower figure is of the same patient in the dorsal position, and shows the characteristic flattening of the abdomen, due to the recession of the ptosed internal organs, and the bulging at the flanks.





Form of young woman in which degrees of splanchnoptosis are met with. Note the narrowness of the thorax, particularly its lower part; the length of the abdomen, and the general poor development of the torso.



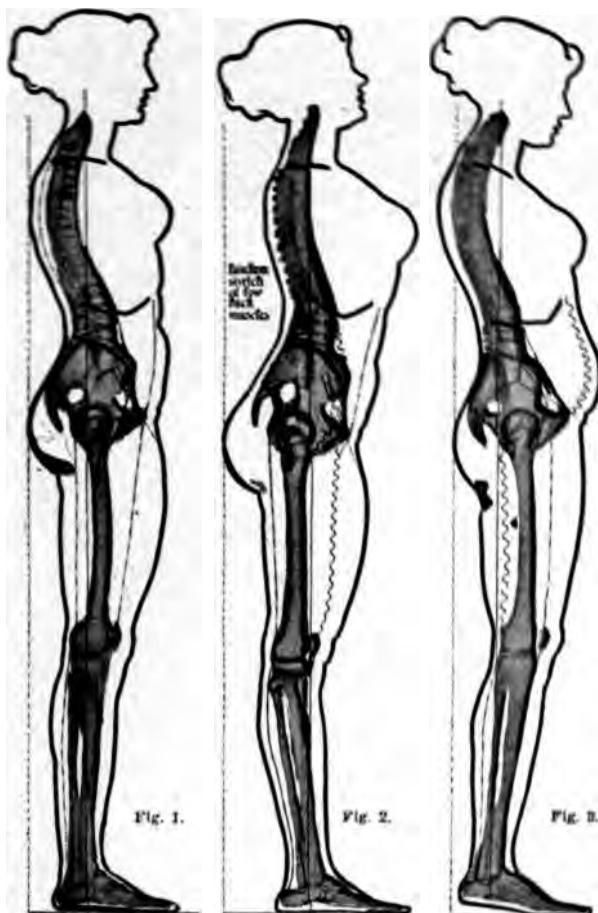


Fig. 137.—Erect postures.

**Fig. 1.**—Normal or neutral type of posture. Distinguishing features are: (1) line of gravity of body passes through important pivotal points; (2) the pelvis is balanced in equilibrium on the heads of the thigh-bones; (3) this relation of important pivotal points with the line of gravity and this balance of the pelvis prevent muscle and ligament strains, and (4) the rear perpendicular touches the middle back and the buttocks.

**Fig. 2.**—Kangaroo type of posture. Distinguishing features are: (1) most pivotal structures of the trunk are carried in front of and those of the lower extremities behind the line of gravity; (2) the pelvis rotates forward downward; (3) the forward-carried trunk puts strain on the spinal and pelvospinal ligaments and muscles, and tends toward forward displacement of abdominal and pelvic viscera. Wavy lines indicate muscles relaxed; dot and dash lines show muscles in action.

**Fig. 3.**—Gorilla type of posture. Distinguishing features are: (1) most of the pivotal structures of the trunk are carried back of and those of the lower extremities in front of the line of gravity; (2) the pelvis rotates backward downward; (3) the backward-carried trunk puts its own variety of strain on the spinal and pelvospinal ligaments and muscles and tends toward backward and downward displacement of the abdominal and pelvic viscera. Wavy lines indicate muscles relaxed; dot and dash lines, those in action. (Dickinson and Truslow.)

prone position the greater curvature is below these points the organ is either prolapsed, dilated, or both, although if the examination is made in the erect position a slightly lower standard of departure from the normal must be taken. Percussion of the stomach is a simple and accurate method of diagnosis, and in my opinion nowhere near so misleading a method as is often supposed, although far short of the X-ray method. After inflation of the empty stomach the limits of the organ can accurately be made out by percussion throughout all excepting the very end of the pyloric region, and under the conditions of artificial distention the colonic resonance (the transverse colon overlaps the lowest extremity of the stomach) can easily be eliminated by the acoustic difference between the two. However, it is always best when in doubt, and when depending upon all methods of examination other than the X-rays, to examine the stomach after a purge or enema to unload the colon. When confused, one can get a fair idea of the degree of gaseous distention of the colon by percussion over the ascending or descending portions, noting the character of the percussion note, and after this locating the lower border of the stomach. In so far as percussion is concerned, the point of difference between gastrophtosis and dilatation which Kemp<sup>6</sup> has drawn attention to is most important, namely, that in dilatation the lesser curvature retains its relation to the diaphragm and the distance between the lesser and greater curvature is increased, whereas in gastrophtosis, the entire organ descends, drawing away from the diaphragm, the vertical dimensions of the organ being retained; this rule holds good when only one of the two mentioned conditions exists. Care in examination must be taken so that one does not confuse the dullness of the overhanging left lobe of the liver for the absence of tympanitic note of the stomach. This, as a rule, can usually be obviated (providing the liver is not also puffed) by a rather deeper vertical percussion stroke when nearing the lesser curvature, or by the flexed finger percussion method. The methods of inflating the organ and further points in percussion are described elsewhere. Of much value in percussion is, at points slightly to the left of the midline of the abdomen, to note the positions of the lower and upper curvatures under the three conditions of respiration—rest, deep inspiration and deep expiration. In marked states of gastrophtosis a mobility of the pyloric region of 15 centimeters may be noted under the two extremes of respiration, the greater curvature descending well below the umbilicus.

Another of the objective signs is a loud splashing in the umbilical region noted on a series of downward strokes delivered with the tips of the fingers, or preferably with the ulnar surface of the little finger with all fingers extended and in apposition. This sign, which in value

is still in debatable grounds, is so commonly present in these stomachs that it is a valuable diagnostic measure. It is due to agitation of the fluid stomach contents in the presence of gas, and when found one or two hours after ingestion of fluids a prolapsed stomach with atonic dilatation is generally present, although only the latter may exist. While I am willing to admit that this symptom may be noted in thin and apparently healthy persons, still, when marked, it always represents myasthenia or atony, or prolapse, or both, or else stagnation from some cause. A healthy stomach is usually capable of contracting strongly enough upon its contents so as not to permit of such splashing. Care must be taken that the splash produced is not in the colon, but in these instances a diarrhea usually exists, and by placing the ear over the upper regions of the stomach and shaking the patient the succussion sounds produced in the stomach are usually confirmed, because, as described elsewhere, the best plan in flicking is to approach the stomach from below the organ and continue beyond it.

Another valuable suggestion in the diagnosis is epigastric pulsation from the abdominal aorta, which was emphasized by Glenard. The noting of this usually means that the stomach has descended and there is none of the organ between the hand and the vessel. This sign is of the most importance when noted at the time that the stomach contains food, for the simple reason that the pulsation of the vessel may sometimes be felt or seen through the walls of a collapsed stomach. This is best observed in the prone position.

The gastroduaphane may also be used to note the location of the lower curvature, but is not of much value to map out the other areas. Its use is unpleasant, requires the drinking of large amounts of water for the examination (which is harmful), and also a special apparatus, a battery, and much time in the examination. The string test may be employed, but it is not to be depended upon. In marked gastrophtosis the stomach is lengthened so that the distance from the cardia to the duodenum, which normally along the lesser curvature is rarely beyond 20 cm. (8 inches), may reach to 24 cm. (9½ inches, or more). Thus it is that the area of bile stain at the end of the string will be distinctly shortened. The reason that this is not a safe means of diagnosis is because more or less atony of the pyloric region and relaxation of the pylorus may exist, allowing of regurgitation from the duodenum into the stomach, and a staining of the string down to the limbus of the pyloric region.

But of all signs and methods, the surest and most definite is observation by the X-ray-bismuth method of examination. By the employment of this means the location, size and shape of the entire

organ from the fundus to the pylorus is accurately noted, and, best of all, the examination can be made in the erect position, in which position, of course, the patient spends two-thirds of each day, and in which the stomach bears the normal relation both as to position and function during digestion. By another observation in the prone position, the mobility of the organ can easily be noted, which is not only an important practical feature in the diagnosis of prolapse (as well as many other gastric affections), but also in the therapy for that condition. (For which see Chapter V.)

It is a most common clinical finding that when a kidney is felt (nephroptosis) gastrophtosis is also present. The noting of the gastric secretion is not of much value in diagnosis. Some authors (Steele, Francine, Brown) claim that subacidity is the rule. In my own practice I have not found this to be true, the cases being about evenly divided into the three conditions (in 172 cases of distinct gastrophtosis I found normal secretion in 51, hyperchlorhydria in 47, subacidity in 68, and anachlorhydria in 6). An averaging of the gastric acidities found in those cases advanced to the extent of displacement of the pylorus 5 cm. and more, a marked sagging of the stomach giving it a U shape, and those in which from the fundus to the upturn of the pyloric region the stomach inclines to the left confines of the abdomen instead of directly downward (which is moderately ptozed) or to the right (which is normal) shows that there is a distinct tendency toward a diminution of the free acid, and that achlorhydria is frequently met with. I can hardly go so far as to state that the diminution of the acid depends upon the degree of descent, as has been reported by Brown, but I do believe that the tendency is in that direction, and as the case with a lowered or absent acid improves, after some months of treatment, a return of the free acid is a concomitant occurrence. More commonly present, however, is a sensory neurosis in varying degrees, in some of the cases bordering upon a distinct gastralgia. Unless dilatation or stenosis is a feature, the motility in these stomachs is good, this being in by far the largest number normal or just a trifle short of it. A degree of chronic gastritis is not an uncommon accompaniment, having been met with in 11 per cent. of the above-mentioned cases.

**Nephroptosis.**—The diagnosis of movable kidney is quite easy, but more difficulty is usually encountered in deducting as to whether the symptoms present are due simply to detachment of these organs or to the more complex make-up of splanchnoptosis that is generally present. Quite naturally, these organs, because of their small size, deep situation even when low, or mobility when freely movable (floating), cannot be diagnosticated on inspection or percussion. The

same may be said with regard to the X-ray method of locating their position by the ordinary methods of radiographic technique now general, although recent work along these lines by the employment of a deeply depressed diaphragm has made it possible to obtain some excellent plates showing a kidney shadow away from the fosses.

The main means of diagnosis is by palpation of the kidneys through a relaxed abdomen (knees raised and slightly separated and abdomen relaxed). If the kidney is freely movable we may feel the organ upon very superficial palpation, noting it as a hard mass, slipping away from under the fingers when sharply pressed upon, but capable of being grasped between the fingers of both hands when the diaphragm is quiet. A body like this that can be pressed beyond feeling under the liver on the right side, or under the stomach and costal margin on the left, or can be pushed from one side of the abdomen to the other is usually a kidney having a long pedicle, although in rare instances a floating spleen may be met with. If the kidney is not as movable, it would be felt at the side of the vertebral column deep in the posterior abdomen. On these occasions, particularly when the subject is rather stout, bimanual examination becomes very desirable, and it may further be quite necessary to examine the patient after a prolonged hot bath or after the application of a moist, hot poultice about the abdomen.

In my experience, bimanual palpation is best performed in the two-posture method, that is, erect position of the trunk so that the organs are at the lowest level, and then the horizontal to encourage their slipping to a higher plane. This is performed as follows: In examination of the right kidney the physician stands at the right of the patient (sitting) and with the left hand grasps the lumbar region. The anterior thumb must be directly under the lowest ribs while the other four fingers lie flat and well over the back, the arch made by the thumb and index finger being sunk as deeply as possible into the side. The patient is now requested to breathe deeply and slowly, and at a favorable moment at the end of deep inspiration a firm grip is obtained, after which the patient, while holding the deep breath, is made to lie down. The right hand is now employed to make pressure upon the abdominal viscera below, in first a downward and then a horizontal direction under the upper thumb. The noting of a loose kidney slipping upward under the left thumb is very distinctive and characteristic, and often somewhat distressing to the patient. In examining the left kidney the physician stands at the opposite side of the patient, and the hands are reversed. Under normal conditions the right kidney is just

about palpable on deep inspiration in thin subjects, the left not at all. In the stout, the right kidney is not palpable unless prolapsed.

Symptoms on the part of the kidneys are rare in comparison to the number of cases of movable kidneys that are met with. In some instances there is described a dragging sensation or pain in the back a little above the waist line. In others there is obtained a history of attacks of nausea, coming and going suddenly, which, even in the symptom-complex of splanchnoptosis, may be quite suggestive. When the kidney has become movable to such an extent as to permit of torsion of the pedicle so as to produce kinking of the ureter or



Fig. 138.—X-ray showing a markedly prolapsed left kidney in contact with the anterior abdominal wall, situated to the left of the vertebral column and above the umbilicus, and a gastrophtosis of marked degree with dilatation of the pyloric region. Attacks of Dietl's crises were prominent in this case and subsided after the kidney was anchored. Markers at the ensiform and umbilicus. (Made by author.)

renal vessels or torsion of the renal nerves, the so-called "Dietl's crisis" may be present. This is observed as a sudden attack of nausea, vomiting, and severe pain in the renal, along the course of the ureter, and the bladder regions. During the seizures, the pulse is small and frequent, the skin cool, a cold sweat bathes the body, and the patient is most anxious at the acute distress. Following the attack, albumin and blood may be found in the urine, and in pronounced cases hydronephrosis, pyonephrosis and pyelitis may also be present. An X-ray plate may show such a kidney lying in contact with the anterior

PLATE XC.



FIG. 1.



FIG. 2.

Method of Bimanual Palpation of the Kidneys.

Fig. 1.—Patient sitting. The thumb and index finger arch of the hand sunken into the side close to the small ribs, the thumb making deep pressure at the end of inspiration, the other fingers on the back.

Fig. 2.—Patient lying. The other hand making deep and upward pressure on the under viscera, delivering these under the upper thumb.



abdominal wall, providing it be taken with the patient lying with the abdomen upon the plate. The following one shows this plainly:—

**Hepatoptosis.**—The symptoms of wandering liver are manifest, for the organ is so large that when displaced this is readily recognized on palpation and percussion. It is a good practical rule to follow that a liver which is palpable below the costal arch in the mammillary line is either enlarged or prolapsed, and the plainer the edge is felt the surer it is that it is enlarged from inherent disease. Noting the lower edge or obtaining the characteristic dullness on percussion in the abdomen, it is then essential to observe the vertical dimensions of the liver by percussion. At respiratory rest, the upper limit of the right lobe runs about on a horizontal line from the junction of the fifth right costal cartilage with the sternum horizontally outward to a little below the nipple, and then it is inclined downward to reach the seventh rib at the side of the chest. The upper limit of the left lobe (which on account of its relative thinness to the right lobe, and the overlying sternum and costal cartilages) is not so definitely percussible but runs on a line from the starting of the above to about a point on a level with the sixth left costal cartilage, the extremity of the lobe being at about 5 centimeters (2 inches) to the left of the sternum. It must be remembered that on deep inspiration the upper limit of the organ is lower than the above, and on complete expiration it is higher. There are no symptoms in particular referable to this organ in conditions of prolapse, and those present in a case are those of splanchnoptosis in general. In my experience, these cases of prolapse are always severe in their clinical make-up, and are difficult to obtain results on.

**Splenoptosis.**—Displacements of the spleen are very rare. Such instances may be observed in accumulations in the left chest, whereas a palpable organ due to valvular lesions, hepatic cirrhosis, typhoid, malaria, leukemia, etc. usually means its enlargement and not prolapse. Even more markedly so than with the liver, a palpable spleen is always enlarged or prolapsed. These are best noted by examining the patient in the prone position, the organ appearing from under the depth of the costal arch, the hard, round, sharp-edged mass being projected on deep inspiration. When feeling such a mass some confusion may arise as to whether it is the spleen or the left kidney that is felt. In differentiating these it is important to remember that the spleen is much less frequently prolapsed than the left kidney, that the spleen usually projects from the depth of the costal arch and in an oblique line forward toward the umbilicus, and that the kidney is always more deeply situated and projects along the vertical line of the vertebral column. The absence of the splenic dullness from its normal area, and the

noting of one or more incisures along the anterior border of the mass are also helpful in diagnosing prolapse of the spleen.

**Coloptosis and Enteroptosis.**—These are most commonly met with in Landau splanchnoptosis, for in men and nulliparous women marked states of prolapse of the intestine are only found about third in frequency to those of the stomach and right kidney. The condition can be assumed when the abdominal wall is lax and pendulous. Among the more definite subjective symptoms are: constipation possibly alternating with a diarrhea, fermentations and borborygmus, dragging sensations in the back, and, from the colonic catarrh, the passage of mucus (both fluid and in shreds) with or without stool.

In so far as the objective symptoms are concerned, the only method of examination that has served to definite purpose in my hands is the use of the X-rays. To these ends the bismuth mixture is taken by mouth and the exposure made twenty-four or thirty-six hours afterward, when the bismuth would be continued in the colon, or better than this is to inject about 100 c.c. each of water and syrup of acacia in which about 50 grains of bismuth subcarbonate have been suspended. The injection is given after the bowels have moved well, the patient lying on the left side or at first in the knee-chest position, and the exposure made one hour afterward when the bismuth had been carried by the antiperistalsis into the ascending colon. A routine that serves to the best clinical purpose in cases of splanchnoptosis is to give the bismuth-food mixture and make a fluoroscopic observation or plate of the stomach, after which the patient returns on the next day and an X-ray picture is taken of the colon. Observation in the interval between these times for the purpose of noting the small intestine are usually valueless for the reason that the bismuth distributes itself throughout the coils of the small intestine and only a large black shadow area with no detail is produced. For the colonic observations by X-ray, the fluoroscopic screen does not equal in value the making of plates. Another method is to employ air for the purpose of demarcation, using a tube and a hand bulb to distend the colon (which gives dark areas on the negative instead of the light ones of bismuth).

In the absence of an X-ray examination, the location of the colon may be fairly well made out by distention with air per rectum and physical examination. The hand bulb attachment for distending the stomach (page 127), excepting with a rectal tube or simple nozzle attached, may be employed for the purpose. Preparatory to the observation it is essential to clean out the colonic contents by a purge given the night before (castor-oil best), or an enema just before the examination is made. The tympany of the stomach (which is confusing in mapping

out the colon after distention) is best obviated by the examination being performed shortly after the taking of a meal. The tube is introduced as high as possible, and when *in situ* the patient lies on the back. Air is then pumped into the gut in amounts necessary to obtain a well-defined tympanitic note on percussion over the descending colon. As one rarely can achieve more distribution of the air than in the descending and transverse colon, we must be satisfied with this. I have observed on a number of occasions that, if some time is allowed between the introduction of the air and the examination (ten or fifteen minutes), better results in the way of mapping out the transverse colon are obtained.

A toxemia from the intestine, of the mixed or indolic form, is commonly present in these cases. In such a colon extensive areas of destruction of the mucosa, sacculations of foul masses of feces, numerous ulcerations, and dilatations are met with. When this chronic toxemia of the aromatic sulphates, ammonia, sulphureted hydrogen, butyric acid, etc., has existed for a great length of time, the general condition of the body may display such states as gastric hyperacidity, serious forms of headaches, certain forms of iritis and other ocular disorders, extensive mucous inflammations, manifold evidences of neurasthenias, mental and nervous phenomena, serious joint complications, and not improbably disorders of the ductless glands. A resulting chronic colitis, due to the irritation of the perverted contents in the colon, is a common finding, this condition being of the catarrhal form, and perhaps also affecting the small intestine almost to the duodenum.

**Cardioptosis.**—The possibility of this condition is suggested after the diagnosis of splanchnoptosis had been made. In a normal individual in the left lateral position the displacement of the heart is on an average 2 to 3 centimeters to the left, and in the right lateral position about 1 centimeter to the right. As is well known, the normal site of the apex beat is in the fifth intercostal space about one-third of the way from the mammillary to the midsternal line. In the absence of organic disease of the heart or the lungs, a displacement of the heart is easily noted by palpation and percussion. A downward displacement of the base of the heart in the midline to the level or below the fifth interspace is suggestive of cardioptosis. This observation had best be made by X-ray.

#### TREATMENT.

Many more cases of splanchnoptosis exist without symptoms than with them, therefore, at first no treatment is necessary and it is

best not to strongly emphasize to the individual the existence of the condition. It is always well, however, to give such persons advice in a general way so as to guard against the development of symptoms at a subsequent time. Among such may be mentioned the use of tonics, hygienic measures, corsets and belts, special attention after parturition, etc. With such individuals as can add to their comfort matters of a prophylactic nature, the chances of the development of symptoms are small. For these reasons it is well to observe the child and advise mothers on these points in susceptible children. Unfortunately, the first time that practically all of the cases are seen is in those of adult years and in whom the symptom-complex is well established. In these, as a result of careful and persistent treatment, a success is met with in the way of relieving the symptoms in the great majority of instances. In the very rare cases of only one organ affected, or a single organ being sole producer of the symptoms (kidney), surgery has afforded some signal results in the way of relief and even cure. It must be obvious that, when a complicity of organs has been ptoosed for years, complete cure cannot be expected to be brought about by medical or even surgical means. To substantially relieve the patient of the symptoms produced by the loss of compensation, the interference with functionation, the general neurological symptoms, etc., is the limit of hope we have any right to entertain. But in these there is a small proportion of cases in which, even with most persistent medical and in the face of the most serious surgical treatments, the results always remain discouraging. These unfortunate individuals are to be viewed truly as subjects of a chronic illness, as are most of the cases of organic affections. We can relieve them from time to time, and with great care they live out their allotted years of life. Splanchnoptosis is not a fatal condition, the severe and long persistent cases succumbing only to resulting or intercurrent affections. In a general way it may be stated that, with an intelligent and willing patient, relief of the symptoms and a marked improvement in the general health is possible. It being a congenital and constitutional condition, this takes months of time.

**Prophylactic.**—To prevent the development of symptoms in splanchnoptosis, it is important that the tendency to its production should be observed early and the prophylactic measures carried out. Children ( and young adults) with the characteristic body form should be recognized and made to live accordingly. Insistence should be placed upon the necessity for abundance of fresh air and outdoor exercise. Their foods should abundantly comprise such articles of diet as

have the greatest nutritive values in the smallest bulks. The dietetic caprices of the child should be met with a stern insistence upon the taking of such foods as would maintain the highest status of nutrition. Among these may be mentioned the employment of eggs, meats,

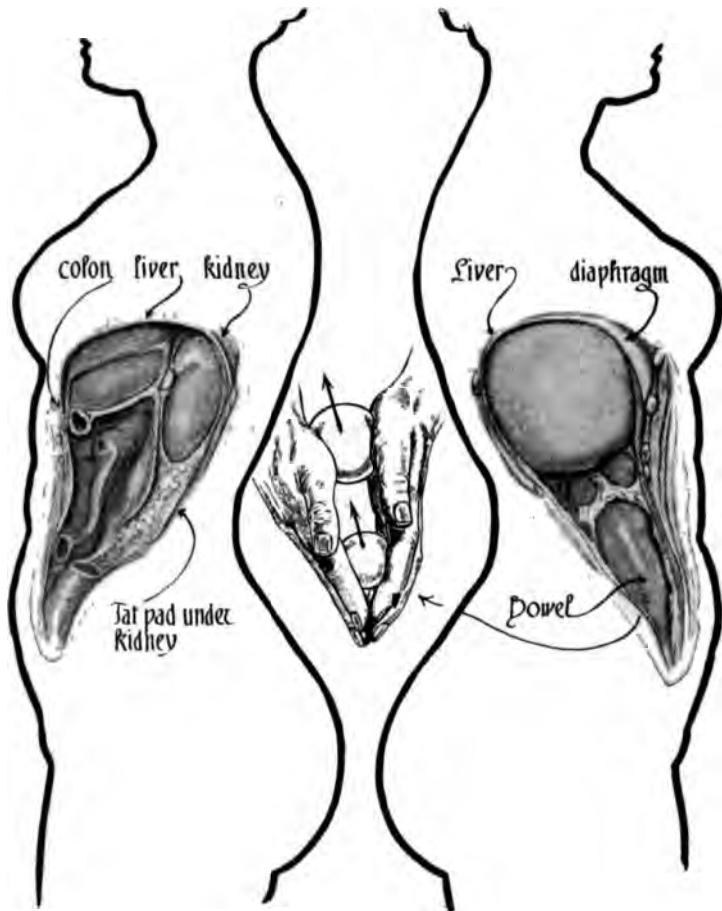


Fig. 139.—Nature's corset, the anterior abdominal wall: normal wedge-shape of abdominal cavity (from Cornung): Strong front muscles hold the organs, or lift them up along the posterior slant. (*Dickinson*.)

poultry, fish, butter, cream and milk; the high albuminous vegetables, such as peas, lentils, beans, and grains; and the heat and energy makers, starches, sugars, and the fats. A rest of an hour after eating is often advantageous, and early retirement to bed should be strictly followed. Effort should be made when the children are old enough and

with all adults to develop the strength of the diaphragm, the intercostals, and the abdominal walls by deep-breathing exercises in the hope of enlarging the lower thoracic zone, as well as other chosen exercises to develop special groups of abdominal muscles. When the girls are old enough to wear corsets attention should be paid that the waist-compressing styles are not selected, and that tight lacing is not permitted. In the adults the ordinary straight-front corset should be worn in preference to none at all, and this should be tightly laced below the transverse navel line and kept as loose as possible above it. In youths and men the wearing of a belt may be permitted, but the rise of the trousers should be short enough so that the belt just fits above the iliac crests and not at the waist line (this manner of wearing a belt, to my belief, is even to be preferred to suspenders in all instances).

Attention should be paid to all persons, whether children or adults, after an acute or chronic illness associated with loss of weight and body tone that they receive prolonged medical attention, and not get out of bed or return to work too soon. The employment of systematic overfeeding, tonics, regular hygiene, and possibly a sojourn in the country should be advised. These rules apply in cases of measles, scarlet fever, pneumonia, diphtheria (particularly in the presence of complications) to almost the same extent as they do to typhoid fever and other prolonged fevers. Care is necessary after the reduction of weight in obesity cures, because, if the loss of weight be too rapid or too pronounced, a general loss of tissue tone results. The same holds true after operations for the removal of large-sized abdominal tumors or the removal of ascitic fluid; because of the reduction of intra-abdominal pressure without sufficient retraction of the abdominal wall to place the parietes in a condition to sustain the organs. Since the aftermaths of pregnancy make up the bulk of these cases, a few words on this subject would not be amiss.

Quoting from an article of mine written and published in 1907 (Bassler<sup>7</sup>), I again present the following: "The gravid uterus at term occupies practically all of the available space in the abdominal cavity, particularly when the woman is in the prone position. It reaches superiorly close to the under surface of the liver, and in breadth almost to the limits of the lateral confines of the abdomen. In the upright position the intestines are posterior to the uterus; in the dorsal position they lie chiefly to the sides, but partly, too, in front, of the uterus. In the upright position the uterus in advanced pregnancy rests upon the anterior abdominal walls, the component tissues of which are immensely stretched and somewhat thinned. The fasciculi of the recti and lateral muscles increase in length, slightly in thickness, but not in numbers. The joining borders

of the recti, especially below the umbilicus, separate, causing a weak space in the forewall of the abdomen, which persists more or less after the delivery.

"In even the most favored cases a certain degree of relaxation of the abdominal parietes, with some accompanying degree of ptosis, persists after pregnancy. In a strong, well-nourished woman this remains without the development of any subjective symptoms and may be considered physiological. But under less favorable conditions there is always a danger of the loss of sufficient sustaining power of the walls, persistently encouraging still further descent of the organs within. The recti are the main factors in this, the lower segments of which muscles are usually found bulged forward and the upper segments loose and flaccid. Thus, here we often see the mechanical elements of cause found in these cases.

"Another basic cause in Landau cases, as well as in all cases of ptosis, is subnutrition. The pressure of the gravid uterus on the digestive organs gives rise to many functional disturbances. There is diminished intestinal activity affecting the digestion of foods, and this is more commonly the cause of constipation than obstructive pressure of the uterus. The blood changes incident to pregnancy may also affect the nutrition unfavorably. In the early months there is a hydremic condition of the blood, and it is always questionable if the enriching of the blood in advanced pregnancy in hemoglobin and total number of red blood-cells is equal to the greater demands that are made upon it. There is generally more or less vomiting and gastric disturbance, due to spasmodic contraction of the stomach and diaphragm. The vomiting may be severe and persistent enough to keep the woman undernourished for some time. The vital capacity of the lungs is diminished, interfering with the proper oxygenation of the blood. The taste and smell are often affected, so that there may be repugnance for food of the best kind and there is often found insatiable demands for food of a low nutritive value. To all these there may be added a length of intoxication of the body due to the pregnancy and more or less impairment of the renal function. And, last, to the mechanical and nutritional changes are added the nervous ones, making complete the great triumvirate so often seen in cases of splanchnoptosis. The nervous system during pregnancy becomes impressionable, so much so that in some women already so predisposed it may terminate in insanity, and how simple it is to understand that the great factor of neurosis in digestive disturbances could easily make its beginning here!"

"It is interesting to observe that in the histories of 86 consecutive clinical cases of women who had been pregnant and came under my observation for treatment of some continued digestive disorder, in 21 a state resulting from pregnancy was believed to be the weight that overthrew their former balance of health. Of these 21 cases, 15 were primiparas and 6 were multiparas. Of the 15 primiparas, the average age of which at the time of their delivery was twenty-two years, the average length of time for the development of subjective symptoms was 5½ months after parturition. Taking the single-child cases, for they are the best in point, they were all cases of plainly evident splanchnoptosis of one or more of the abdominal organs, combined with various disorders of motor, secretory and sensory origin.

"An abdominal cavity which has been subjected to a rising internal pressure for months, when suddenly collapsed, from whatever the cause, suffers a shock. What other explanation can be given to the chill immediately following delivery? Then come the long days of slow return of the walls and their contents to the normal condition. In this light, where is contained the wisdom in the growing custom of late years of advising against the use of the old-fashioned binder which does so well in equalizing the lowered intra-abdominal pressure by its support to the walls? The only reason I have been able to obtain for this change in practice is that a tight-fitting bandage is liable to malpose the uterus and thereby possibly favor the establishment of some permanent malposition of this organ, or that the binder was very liable to be soiled and therefore uncleanly and unsurgical. The first is about as absurd as the second is indicative of neglect. It is true that at the post-partum visits the binder is usually found loose and above the iliac crests, but is this not due to carelessness on our part in failing to instruct the nurse how to properly apply the bandage? That it is an uncomfortable appliance to the woman is not borne out by her statements, who, if anything, gladly welcomes the support that it gives even to the very end of resolution, which in a normal case usually takes about six weeks' time. And the last prop is knocked from under the argument when it is contended that it is too warm and distressing a thing for a patient to keep on in summer, when the thinnest skirt she ordinarily wears is not less warm.

"As soon after delivery as possible, in all cases, a bandage should be put on. It should be wide enough to extend from the middle third of the thigh to the ensiform process. It should be shaped to the abdomen by being tucked at the sides from above downward, and be boned in the back, at the sides, and in front so that it stays in place. At intervals during the puerperium the abdominal wall should be

nined to note its muscular power, its tone, and general condition. This is best done while the patient makes effort at straining as if stool. Attention should be paid that the bowels move freely and gases are not permitted to accumulate in quantity. The bandaging should be kept up for at least two months after delivery, and for four to six months in cases in which the abdomen is inclined to remain flaccid and pendulous. Should the danger of splanchnoptosis be great, as she is about, an elastic belt or a proper-fitting corset should be used instead of the muslin bandage, which is not so comfortable for



Fig. 140.—Case showing the development of the abdominal muscles by exercise. E. L., aged 26 years. Primipara. Delivered August 1, 1906. Normal labor of eleven hours; slight perineal laceration; child weighed  $7\frac{1}{2}$  pounds. Kept up her exercises for five months after delivery; gained  $10\frac{1}{2}$  pounds. Photograph taken  $7\frac{1}{2}$  months after confinement.

notion. One such as I ordinarily use in Glenard's disease is good. This belt possesses an advantage over others in that in addition to support it raises the lower abdomen upward as well as backward by the use of what may be called an artificial mesentery, an elastic strap which tends to approximate the lowest point of the abdomen in front to the highest point of the belt in the rear. This strap is adjustable to different degrees of tension. The belt itself is specially constructed to take this low and high position. There are those who contend that an abdomen so supported for a length of time

by the belt or corset loses its tone and afterward the patient becomes dependent upon such support. But as the bandage or belt does not interfere with the action of the abdominal muscles, and as a support from without neutralizes the further baneful vis a tergo of the sagging viscera within, this contention is not well taken. If any effect is seen by the use of either of them it is one of added tone and benefit. I am not averse to a bandage or belt being worn for six months after delivery in all women.

"In imminent cases, at such times as it is deemed advisable, efforts



Fig. 141.—Case that showed the highest gain in weight. A. W., 27 years old. Primipara. Delivered November 17, 1906. Child weighed 10½ pounds. In active labor twenty-one hours. Troubled with "nervous indigestion" before her pregnancy, not since. Weighed March 2, 1906, 129 pounds; three months after delivery weighed 160 pounds. Perfect result. Nursed her child and claims she never before felt so well.

should be made to strengthen the muscles by exercises, the most valuable of which are voluntary contractions of the abdomen by the patient, frequently during the day. While difficult at first for most women, the art is soon acquired. The patient's attention should be directed to the lower abdominal zone, and she should try to flatten, by a slow, strong, and deliberate effort, all of the abdomen below the navel. They all soon get control of the lower segments of the recti, etc. This exercise can easily be carried on in bed, and should be kept up for several weeks at least. The only other exercise possible while in bed is the raising of

the body to a sitting position. To do this properly the lower extremities should be held down. When she is about the house this is best done by the woman putting her feet under some heavy piece of furniture and raising herself from the floor with her arms extended over her head. The third best exercise is the raising of the lower extremities, with back on the floor, by stout women to the vertical position; by slim women the toes may be made to touch the floor over the shoulders. The fourth and fifth movements are carried on while standing with heels together. They consist of a rocking motion down from side to side, and a twisting motion



Fig. 142.—Case that showed the poorest abdomen and the least gain in weight. Primipara, 27 years old. Delivered January 3, 1907. Infant weighed  $7\frac{1}{4}$  pounds. In labor three hours. Photograph taken three months after delivery, showing the long, narrow abdomen with still good configuration. Woman perfectly well. Discarded the bandage, but still exercising.

of the trunk, first one shoulder forward, then the other. In loose clothing these movements should be engaged in mornings before the belt is put on, and evenings after it is taken off for the night. In imminent cases they are very valuable measures and should be insisted upon strongly. Abdominal massage, electricity, and hydrotherapeutic measures I merely mention as not deserving much attention in the routine of these cases.

"In all cases of women who have been delivered, and for many weeks afterward, the diet should be of the highest nutritive value and pushed to the very limit of digestive capacity. The meals should be small in bulk and frequent. Food every three hours is not any too

often in an imminent case. When the patient is about and taking three meals a day, supplemental meals of milk, eggs, bread, butter, and so on should be advised. When the danger of ptosis is great the giving of much fluid should be guarded against. The choice of food should be liberal and it is often wise to disregard any mild dyspeptic disturbance and feed the woman generally as well as generously or she runs the danger of being underfed. It is best to lay out a plan of diet with the quantities, and insist upon her meeting it. The main purpose of the diet is to add rapidly to her weight. The carbohydrates are strong factors in this. This forced feeding is also of value to nursing women and the anemic and poorly developed.

"It is often beneficial to make the seeming mistake of keeping the woman in bed too long. She should be encouraged to rest after her heavy meals for some time, and warned against any fatiguing or violent efforts for two months. In cases in which the abdomen remains pendulous and the walls weak, it is wise to advise a morning and afternoon rest of two hours with the buttocks raised so as to have the viscera gain a higher level in the abdomen. Another good plan is to have her sleep for some weeks in a bed raised at the foot end.

"At the time of making these observations and through the kindness of several friends, I interested myself in thirteen first-baby cases attended by four different practitioners of medicine of this city. While the number was too small to gain more than a general idea of the benefits possible to accrue from attention and treatment along the lines of preventing splanchnoptosis, still there were some very striking results from the exercises, high feeding, careful bandaging, etc. In every case fifteen months after delivery none of the women had any significant digestive disturbance, and in all the abdominal walls were in good condition. Their gain in weight ranged from 7 to 31 pounds over their weight before the beginning of pregnancy, and none failed to show a gain between these figures.

"Of the seven who may be classed as neurotic women, in six the nervous condition had been much benefited. Three of them I had reason to believe were tubercular subjects, and in one there was a question of syphilis, although the infant showed no lesions up to the sixteenth month. Even these four were in better health than they had been before. Seven of the women were slim, and four of these were distinctly of the long, narrow thorax and abdomen type in which conditions of prolapse are so common; still, none of them developed any digestive troubles whatsoever. All but one nursed her infant, and the average shape of the abdomen as well as the condition of the wall compared most favorably with the single-baby cases followed by

splanchnoptosis that I saw at the clinic. I do not doubt that with successive pregnancies their abdomens, even with the same degree of care that was given them during the first parturition, may not be so good. Nevertheless, I feel that the efforts of these women were not in vain and the treatment was not trying or irksome, and also that more general use of post-partum treatment like those carried out would give material and lasting benefit to those mothers in whom sacrifice of health is the price they pay for giving birth to children."

**General Treatment.**—These comprise those measures which will build up nutrition and vitality. The diet for splanchnoptosis should be abundant in foods having the highest nutritive value for the bulk, and a special dietary, also outlining the plan of meals, should be given to each case. One should be careful not to permit these patients to partake of too large meals or much fluids of any kind. Moderate-sized meals, each being about the same in quantity and character, are better than a small breakfast and luncheon followed by a large dinner taken at the time of the day when the physical and nervous energy is at the lowest ebb.

In the effort to add sufficient nutrition and also to restrict the bulk, the proteid foods answer to best purpose, but to these should be added the fats and carbohydrates so as to preserve the tissue metabolism and to prevent monotony. Glenard advised a diet consisting mostly of meats, and gradually adding stale bread and green vegetables, but avoiding acids, wines, cereals and fats. In my opinion, the diet should be mixed from the start (regulated possibly to a degree but not to too great an extent according to the gastric analysis or in the effort to overcome constipation).

When anorexia exists and only small amounts of food can be taken at a meal, raw eggs, or half milk and cream, a sandwich, cocoa made with milk, etc., should be taken in the intervals and before retiring. By the more frequent feeding (and a four meal a day plan of feeding answers well when supplemental meals are not practicable), the danger of gastric dilatation is eliminated, and that present is benefited. Also, the steady method of feeding adds weight more rapidly, and, as this increases, the symptoms usually subside. The dietary need not be built up on quantities according to calories for the day, but the caloric principle should be considered in the selection of foods so that the best values make up the largest proportion. A few rules that will be found helpful in practice is to employ the three meal a day plan when the appetite is good, the three meal a day and supplemental meal plan in cases of anorexia or in those who are employed in business, and the four meal a day plan with those who have marked

anorexia or who live domestic lives. Although Glenard has advised against the use of fats, in my practice they have been most helpful, excepting in a few cases of fat intolerance. A dietary list something like the following, which can be made up on a three or four meal a day plan, is recommended:—

The plan of the diet is to eat.....meals a day; to eat moderate quantities of food, taking about the same amount at each meal, and not to partake of anything in the fluid line, not even such fluids as soups, coffee, tea, cocoa, water, milk, etc. The foods should be cut fine on the plate, well chewed, eaten slowly, and you should lie down for about an hour after each meal, and not eat when physically exhausted or when under mental strain without first resting for a time.

The best foods to take are any of the well-cooked cereals, using plenty of fresh cream and a moderate amount of sugar with them; eggs in any form, taking at least four in the course of a day. Fresh fish, boiled or broiled, about three times in a week; beef, lamb, mutton and chicken, roasted or broiled; beef tongue or heart, ham and bacon, one or more times a day, and these should be of tender quality; bread, crackers, rolls and cake, not too fresh, should be eaten twice a day, and effort should be made to use as much fresh butter on them as possible, as well as on all of the other foods; salads with plenty of olive oil and very little vinegar and salt taken once a day; the best vegetables are plain or sweet potatoes, mashed or baked; peas, beans and lentils; dried, ground or whole fresh corn, and occasionally a little mashed turnips, spinach, carrots, all of which should be thoroughly cooked; desserts made of milk, eggs, cream and cereals can be taken, but no fruits or berries; Neufchâtel and Philadelphia cheeses are allowable.

Other matters of importance in the diet are: Considerable fats should be taken during the course of each day. These may be given in the form of fresh cream, of which a half-pint should be taken each day, and fresh unsalted butter in abundance. The constipation had best be relieved by dietetic means, and for this bran-gems, agar-agar (handful each day in cream or fruit juices), a dish of prunes sweetened with milk-sugar instead of cane-sugar, or from a teaspoonful to a tablespoonful of petroleum jelly (vaselin) at night before retiring. Resting on the back for at least an hour after the main meals should be encouraged, and sleeping in a bed which has the foot end elevated from three to six inches is a good measure. A plan of tonic-food construction that I have employed with success in many cases is the following:—

R. Tincturæ nucis vomicæ,  
Tincturæ valerianæ ..... 20.0 3v  
Liquoris ferri albuminatis ..... q. s. ad 200.0 3vij  
M. et sig.: Take two teaspoonfuls on cracked ice after meals.

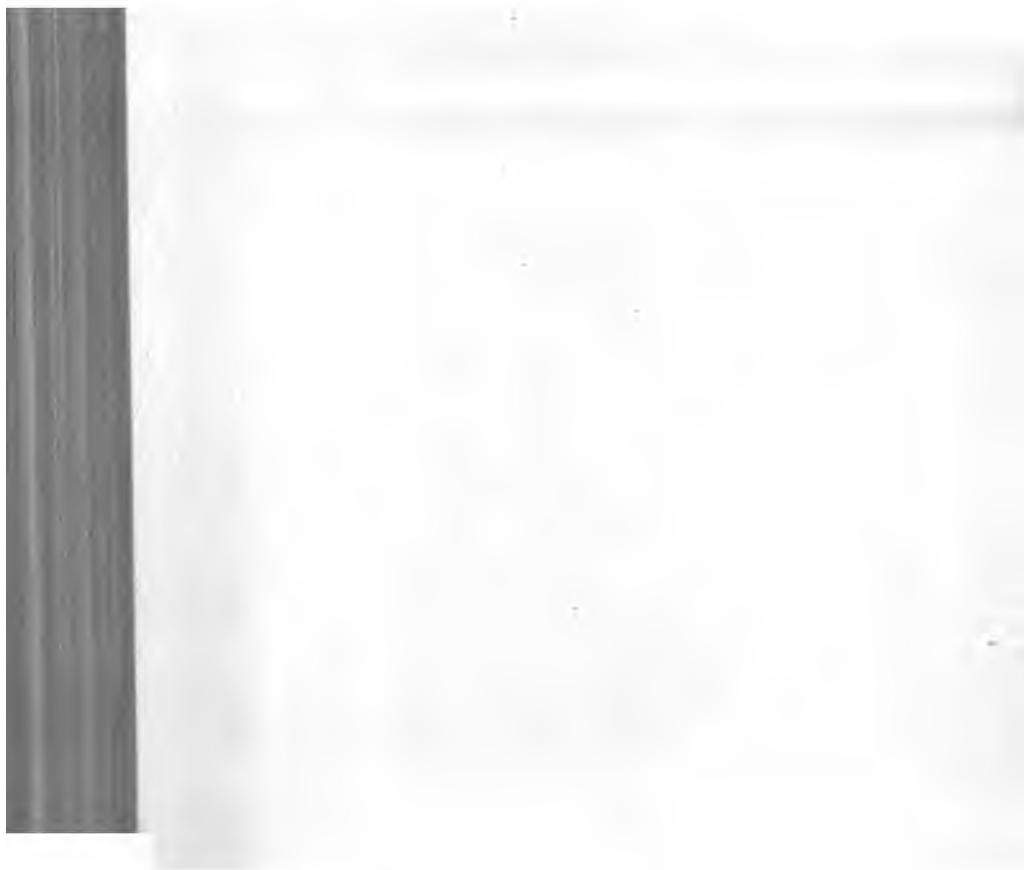
R. Olei amygdalæ dulcis (expressivum) ..... 60.0 3ij  
Extracti malti ..... q. s. ad 300.0 3x  
M. et fiat emulsum.  
Sig.: Take 1 tablespoonful plain, in milk (best reinforced with fresh cream), fruit juice, or light wine midway between meals.

As will be explained, a division of these cases should be made into the mild or moderate ones that recover on ambulatory treatment, and those in whom rest in bed is advisable in the beginning. In those who

PLATE XCI.



Author's corset on a slim woman, a case of attenuated and prolapsed stomach and palpable right kidney. Hook and eye steels on the stomach side of abdomen. Laced in the midfront and closed in the back. Two sets of laces used; the first, beginning at the bottom and bringing the corset tight together up to the umbilicus; the second, running from the umbilicus to the top and being loose so as to obviate all waist line pressure and permit of full diaphragmatic breathing.



are about, attention should be paid and advice given on those hygienic measures that build up physical strength. Hot baths should not be permitted, although the spinal hot douche answers at times for instances of insomnia. A morning cold spray or rub with a cold, wet towel is beneficial. These patients should retire at an early hour, sleep in a well-ventilated room, and arise late. Certain carefully selected exercises which are not too strenuous should be advised. Patients should be taught the proper mode of breathing and standing.

**Special Treatment.**—This consists particularly of mechanical measures employed for the purpose of supporting the prolapsed viscera, and measures instituted for developing and increasing the tone of the abdominal muscles. The mechanical measures are fully described in Chapter XII. In the same chapter will be found details pertaining to massage and vibration, electricity, electric vibration, and the active exercises. In this connection it may be added that vibration and electricity, particularly the use of the sinusoidal currents, answer to good purpose in the cases and also for the treatment of constipation when atony of the colon is mainly responsible for it. In a minority of the cases, the morning and evening routines of special exercises are most efficacious in the way of giving permanent beneficial results. Since these can do no harm, and always improve the general state of health, they should be advised in all cases, even should the local benefit from them in the way of relieving symptoms be slight or absent.

**Medical Treatment.**—The main rôles that medicines have in the care of these patients are those of tonic measures for a short time, and those for the relief of the neurological symptoms for the time being. In the first, the most valuable drug is nux vomica or strychnine, which can be employed after the meals and should always be administered in the largest possible doses. Five-drop doses of the tincture of nux vomica or  $\frac{1}{60}$  grain of strychnine are not of much value, but sometimes most signal benefit is derived from 10 to 20 drops of the tincture, or  $\frac{1}{20}$  grain of strychnine at a dose. Results from these should not be expected too soon, and usually only come after a few weeks of constant administration. The benefits seen are lessened dilatation of the stomach and a better general tone to the body, particularly of the neural system. Unless the anemia is pronounced (in which instance the astringent forms of iron would be most useful), the best forms of iron, arsenic, or manganese to employ are: liq. ferri albuminata; liq. ferri peptonatum cum mangano; ferrum reductum; liq. potassii arsenitis in small-sized doses, and manganese dioxide. To control the local and neural symptoms the depressing bromides may be used, but only in signal cases and in small doses. Since in the beginning of treatment some extra means

to relieve the sensory gastric and other symptoms are generally necessary, the following are recommended:—

In myasthenia, neuroses and anemia:—

B Tincturæ nucis vomicæ .....	12.0	3ij
Liquor. ferri albuminati .....	150.0	3iv
M. et sig.: Take two teaspoonfuls after meals in water.		

Or,

B Zinci valeratis .....	5.0	gr. lxx
Ferri reducti .....	4.0	gr. ix
M. et fiat cap. no. xx.		
Sig.: Take one after meals.		

Or, in marked anemia:—

B Strychninæ sulphatis .....	0.07	gr. i
Ferri sulphatis .....	4.0	3j
Potassii carbonatis .....	8.0	3ij
M. et fiat cap. no. xxx.		
Sig.: Take one, one-half hour after meals.		

When constipation and neurosis are features:—

B Tincturæ rhei, Tincturæ valerianæ .....	10.0	3iiss
M. et sig.: Take twenty drops in water after meals.		

Or, when constipation and anorexia are present:—

B Extracti rhamni purshianæ, Fluidextracti condurango .....	15.0	3iv
M. et sig.: Take twenty drops before meals in water.		

For anorexia:—

B Tincturæ nucis vomicæ .....	10.0	3ij
Elixir. gentianæ (N. F.) .....	q. s. ad	100.0 3ij
M. et sig.: Take one teaspoonful (or two) in water well diluted before meals.		

For anorexia and anemia:—

B Tincturæ nucis vomicæ .....	9.0	3iiss
Elix. gentianæ cum tinct. ferri chloridi (N. F.)	90.0	3ij
M. et sig.: Take a teaspoonful before meals in water.		

For the relief of constipation, when massage, electricity, diet and hydrotherapy fail and operation is not indicated, the pills or tablets recommended at the end of Chapter X or cascara are preferable. Sodium phosphate and aloes, as suggested by Glenard, may be employed, but it is best not to use the saline cathartics or aloes regularly. Instances of hyperchlorhydria are best relieved by the alkalies, and those of subacidity by the tonics and hydrosaline measures. In my experience the malt-extract preparations are

valuable constructors and neural tonics in these cases. Other prescriptions that have been recommended are:—

## (EWALD.)

R	Tincturae nucis vomicæ .....	20.0	3vj
	Resorcinolis .....	4.0	3j
	Tincturae cinchonæ comp. ....	90.0	5ijj

M. et sig.: Take ten to fifteen drops every two hours.

## (PEPPER.)

R	Creosoti .....	0.4	gr. vj
	Sodii bicarbonatis .....	7.0	3iiss
	Pulv. acaciæ,		
	Sacchari .....	aa	q. s.
	Spiritus lavandulæ comp. ....	8.0	3ij
	Aquæ .....	90.0	5ijj

M. et sig.: Take a teaspoonful after meals.

## (MUSSER.)

R	Phenolis .....	0.4	gtt. vj
	Sodii bicarbonatis .....	8.0	3ij
	Spiritus ammoniæ aromatici .....	15.5	3iv
	Spiritus chloroformi .....	8.0	3ij
	Misturæ rhei et sodae .....	90.0	5ijj

M. et sig.: Take a teaspoonful after meals and at bedtime.

## (LOCKWOOD.)

R	Chlorali hydrati .....	4.0	3j
	Sodii bromidi .....	10.0	3iiss
	Aquæ chloroformi .....	125.0	3iv
	Spiritus anisi .....	0.4	gtt. vj

M. et sig.: Take a teaspoonful in water after meals, three times a day.

**Ambulatory and Bed Treatments.**—By persistent treatment the mild and moderately severe cases of splanchnoptosis are relieved of the subjective symptoms of the condition. A proportion of these, possibly about two-thirds, are returned to sustained health, but of course with more or less prolapse continuing. Obviously, being essentially a chronic condition, beneficial results of a substantial character are only accomplished after a length of treatment and observation lasting from three months to a year. In the other one-third a more or less prolonged attention is required to keep them in health sufficient for comfortable existence. Even with many of those who had reached the stage of apparent chronic invalidism or inability to work most gratifying results are often obtained. But there is a proportion of cases, usually made up of those with long-standing marked prolapse of numerous viscera, floating kidney, prolapsed liver, the Landau cases developed successively by a number of pregnancies, or those in whom surgical conditions exist in which the ambulatory treatment gives but poor and transient results. Excepting those in whom surgery would be indicated,

these are best helped by the bed treatment followed by ambulatory care of the condition. Among these also in which bed treatment is indicated are the cases that have been treated while up and about and have not made sufficient improvement, and those of the severe conditions in which subsequent short periods of bed treatment (of two weeks' duration) are desirable each year, the best time being in midwinter after the Christmas holidays, namely, January or February.

The bed treatment in all of its essentials is that of the "rest cure," excepting that the element of building up the general nutrition is a more prominent feature ("rest and food cure"). The seclusion of the patient should always be strict, because the more sternly this is maintained, the fewer the visits of relatives and indiscreet friends to the sickroom, the better are the results. For obvious reasons, a general hospital, even when a private room is employed, is not as good as a sanatorium, or, when conditions can be properly instituted and maintained, treatment in the home. An intelligent nurse, gentle yet insistent in carrying out instructions to the letter, and for the time in absolute authority in all that pertains to the patient, and the patient properly isolated and thus prevented from observing the home environments are essential conditions. Among some of the details of treatment are a daily cold, general and spinal spray or immersion, followed by a salt or alcohol rub; hot, moist applications to the abdomen, changed about every two hours, and kept up until the symptoms of abdominal distress are relieved; massage of the descending colon ten minutes three times a day to relieve the constipation; the abdominal exercises toward the end of the treatment; daily irrigation of the colon by a to and fro current in treating a mucous colitis, using a normal salt or weak silver-nitrate solution; the use of electricity in impressionable patients, and the diet and medication.

Of the diet during the time in bed, the plan should be the use of semisolid or fluid foods rather than solid foods like those of meats, although the latter should not be excluded. Fish and poultry, however, are of much benefit. The meals should be given at three-hour intervals, consisting mainly of cereals with cream, soft-boiled eggs, rolls, butter, marmalade, the soft vegetables, farinaceous desserts, and milk or half milk and cream. Effort should be made to give as much butter and fresh cream during the day as possible. Other liquids and fruits are not allowable.

The full treatment should take up about a month, and the return to everyday life should be gradual. As a rule in every case, the first week after the rest cure shows a decided slump in the patient's condition, the patient losing a little in weight and complaining again of

gas and distress. These symptoms soon pass away, but it is well to warn the patients of them in advance, so that they should not become discouraged. As a rule, under this plan of treatment the patients gain about 10 pounds in weight during the bed treatment, with a steady gain in weight following for from two months to a year. The stomach and other organs are usually maintained at a higher level, although this cannot always be depended upon, and thus the therapeutic matters mentioned in the ambulatory treatment must be maintained in a continued way for some time. There is no doubt, as Lockwood has emphasized, that by this treatment the results obtained are decidedly better than any so far devised for the purpose of holding up the stomach. At the conclusion of the bed treatment a properly fitting abdominal support should be worn while the patient is up, and the case continued as an ambulatory one.

**Intestinal Toxemia.**—If a status of chronic intestinal toxemia of the primary type exists this requires correction or the results from the treatment of ptosis is liable not to be sustained. It is the absence of proper attention to this condition that has caused so many failures from both medical and surgical treatment of ptosis. My statistics show in 500 cases of ptosis that a primary intestinal toxemia existed in 49 per cent., secondary toxemia which was cured by attention to the ptosis in 27 per cent. and no toxemia in 24 per cent. To leave an intestinal toxemia is not half a cure. Practically all of the patients have a return of symptoms in the course of a year or so. These gut conditions are also responsible for most of the endocrine imbalances, they being caused in the acquired cases by toxic effects on the secretion of these glands. Subject matter on primary intestinal toxemias will be found in the volume on Diseases of the Intestines, and the chapter on the Endocrines later on in this volume.

**Surgical Treatment.**—It has lately been a matter of contention as to whether splanchnoptosis is a medical or surgical condition. This can never be settled unless finer pathological distinctions are made and the cases are studied individually. There is no doubt that in the vast majority of cases it is strictly medical. Particularly is this true when more than one organ is involved, as is usually the case. On the contrary are the cases, like floating kidney with Dietl's crisis, in which surgery offers by far the best means for relieving the symptoms that are due to the prolapse of one organ. In every case, however, it is advisable to first try the medical measures or the rest and food treatment before even thinking of operation.

The instances in which surgery offers possibilities of results better than those of medicine are: floating kidney accompanied by intermittent hydronephrosis or Dietl's crisis; a displaced kidney or spleen

pressing upon the other organs or upon the sympathetic or genito-crural nerves or upon the ovarian vein, causing subsequent ovarian disease; also torsion of the pedicle of the spleen with swelling and gangrene, and a few cases in which a dilated pouch of the pyloric region hangs well into the pelvis. In cases of marked constipation or obstipation for organic reasons of a mechanical nature much in the way of relief may be obtained by surgery. Among these instances may be mentioned: congenital deformities, strictures, tumors, foreign



Fig. 143.—Suture of the gastrohepatic omentum to secure elevation of the stomach in gastrophtosis (Beyea). The first suture is introduced by beginning above in the strong tissue of the attachment of the ligament to the liver, the needle including considerable tissue. Grasps at short intervals from above downward are then taken until a position just above the gastric vessels at the lesser curvature is reached. Four to six sutures are used (about an inch apart), carried as high and low as possible. When these are tied the lesser curvature is almost in contact with the under surface of the liver.

bodies, fecal impaction, adhesions, angulations, volvulus, diverticula, prolapse of the colon, sigmoid flexure, or rectum, as well as the rectal and anal conditions.

In operations upon the stomach for gastrophtosis flattering reports have been made by Rovsing (56 gastropexies with good results in each) and by Beyea by his method (11 cures in 11 cases). The facts are that in the great majority of cases operations for this purpose

upon the stomach are not capable of giving such good results as are the medical treatments. There are a few, nevertheless, of very marked looping in which most of the organ is like a narrow channel in contact with the left abdominal wall, in which operation might serve to good purpose in the way of relief, but gastro-enterostomy, for obvious reasons, even in the face of marked dilatation, should never be performed; the Beyea method of suturing the gastrohepatic and gastro-phrenic ligaments, which only elevates the organ and does not interfere with its motility, being the choice on all occasions. As an addition to the suturing of the gastrohepatic ligament, the stomach may be supported from below (as well as the transverse colon held higher) by stitching the omentum attached below the transverse colon transversely or in an inverted U shape across the anterior abdominal wall; an addition to the operation best described by Coffey. With the Beyea operation which does not attach the viscera proper, as well as the colon addition which also does not attach that viscera, the organs are left freely movable and the adhesions formed are substantial. The stomach in which it seems indicated to me is the one that has the pylorus to the left of the spine and 13 cm. (5 inches) or more away from its normal position, which is 3 cm. (1 inch) above and 3 cm. to the right of the umbilicus (standing position). In such a case, the splenic flexure of the colon, always distended with gas, further cramps the stomach on its outer side, and this is an important condition to get away from. Another type of case I advise it in is one in which the deformity of the stomach renders it shaped like a leg and foot, and in which there is a large dilated sacculation corresponding to the heel. The operation is simple, with hardly any more mortality than an ether risk. Nephropexy, by stitching the parenchyma in addition to a free dissection of the fibrous and fatty capsule, has practically no mortality, and is capable of affording a practical attachment in about one-third of the cases of floating kidney, the medical measures answering best for those in which the organ is not so freely movable or has recurred after operation. It must be recalled that a successful nephropexy does not cure a splanchnoptosis, and thus should only be advised when definite kidney symptoms exist.

As regards fixation of the liver various operations have been devised, prominent among which are the methods of Billroth, Franke, and Langenbeck. These, however, should not be performed, excepting in the rare cases in which the liver is markedly ptosed. The mortality rate from them is decidedly higher than the operations for prolapse of other organs. Rovsing reports 18 hepatopexies with good results. Unless torsion of the pedicle or pressure upon other organs occurs, prolapsed

spleen is a medical condition, and splenectomy is to be considered as being on the order of an emergency procedure.

In enteroptosis most of the operations that have been done have been upon the transverse colon, sigmoid flexure, sigmoid, cecum and rectum, and usually for the purpose of relieving an obstinate constipation. In by far the largest number of cases of coloptosis, operation is not indicated, and in these colonic fixation should be looked upon as adding one pathological condition upon another. Still operation may be called for when the entire large bowel is down, or when a V-shaped sagging of the transverse colon is marked and a kinking obstruction exists. Prolapse of the small intestine is a non-surgical condition. A marked prolapse of the sigmoid with angulation may require surgery for its ideal relief.

Finally, however, it is my opinion that splanchnoptosis is a medical condition. Many of the cases that have had relief from surgery have shown that this is only temporary, and comparing these in even the extreme cases with those treated medically have proven that the results from medical treatment are far better.

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## CHAPTER XXVII.

### Stomach Conditions in Diseases of Other Organs.

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THE majority of diseases are accompanied with symptoms referred to the digestive system. These, however, are not primarily due to affections of the stomach or intestines, and are usually discussed in the symptomatology of the various diseases. In some of these, particularly in the afebrile and the more chronic forms of disease, the gastro-intestinal symptoms may be marked features in a case, and often group the manifest symptoms so as to bring the case under medical observation. Since mistakes are always liable to be made in the way of diagnosing and treating diseases of other organs for those of the gastro-intestinal canal, it would not be amiss to give a brief description of the gastro-intestinal symptoms or stomach conditions that may be present in the more common forms of general body diseases, and give a short *résumé* of the important symptoms and differential points in those cases that often simulate gastro-enteric disease.

#### DISEASES OF THE INTESTINES.

**Indicanuric Conditions.**—Nothnagel, relying upon the experiments of Jaffé and his own clinical observations, established an important distinction between the large and small intestines as related to indicanuria. Indol, they state, originates in the putrefaction caused by bacteria in the terminal portion of the small intestine, and does not originate in the large intestine even in cases of habitual constipation, although constipation is commonly present in the cases and the intake of indican into the circulation is controlled when the bowels are kept moving. I have already stated that the condition of the stomach primarily is not an important factor in its production, because almost as many cases of indicanuria with excess or normal gastric secretion are seen as with a subacidity or an acidity. Low gastric secretions should be looked upon as a result of the indicanuria rather than the cause of the latter. The instances of red indican and urorosein or indolaceturia, as Herter has described them, for practical purposes, may be considered on a par with indicanuria.

Among the stomach conditions that may be noted in these affections as a result of indicanuric putrefactions in the gut or manufactured elsewhere are: sensory neurosis of a mild type, with a high and then a depressed HCl secretion, prolapse, and myasthenia or atony. The gastro-enteric symptoms most commonly met with are epigastric weight, fullness, and distress, more or less at all times and moderately intensified after eating, disagreeable odor to the breath and bad taste in the mouth, feeling of lassitude and debility after meals, much flatulence in the intestines and constipation, and persistent back pains. With these are observed the results from the dietetic, chemical, and bacteriological examinations of the stools, and the constitutional symptoms of debility, emaciation, neurosis, anemia, and, in long-standing cases, affections of other organs, such as the kidneys, liver and heart, and finally intractable neurasthenia. In my opinion more cases of stomach symptoms and functional stomach conditions are due to primary intestinal toxemias than any other cause. The largest number of functional secretory, motor and sensory disturbances of the stomach are due to intestinal chemical causes. If clinicians and gastro-enterologists would study many of the gastric cases from this angle and treat accordingly more permanent benefits would be accomplished.

**Intestinal Indigestion.**—Together with the above are seen states of intestinal indigestion due to lack of bile, pancreatic or intestinal secretions. Among the symptoms noted are the gastric manifestations of nausea, vomiting, flatulence, and the sensory disturbances of the stomach. The stools usually contain increased amounts of incorporated mucus, may be acid instead of alkaline, and may be fluid, light in color, foamy and of a butyric acid odor (saccharobutyric putrefaction). In instances of intestinal colic, the acute periodical pains accompanied by general disturbances in the nervous system are distinguishing features; in the latter also, whether due to functional or organic conditions, the marked gaseous distention of the bowels associated with loud rumbling or borborygmi are present. In lead colic the constipation and intense abdominal pains, the anemia and pallor, the blue margin of the gum or about the anus, the paralysis of the extensor muscles of the forearm, the high-tension pulse and hard arteries, together with the history of occupation, are helpful in diagnosis.

**Chronic Appendicitis.**—Chronic disease of the appendix often causes gastric symptoms. A chronic lesion of the appendix may exist without ever producing an acute attack. The effects of a chronic appendicitis on the stomach are reflexly brought about, and may be expressed, in the frequency found, as hyperesthesia, hypersecretion, gastric atony, gastro-

spasm and pylorospasm. The intestinal condition of hypomotility and atony of the colon are commonly present. A gastric condition of a chronic nature in a case in which there is present a tenderness on pressure sharply localized in the appendix region should suggest the latter as a cause for the former. When pressure on the appendix brings on epigastric distress, confirmation of this is present. Of the reflex disturbances of the appendix may be mentioned the following types of cases. The pain type of acute colicky pain general in the abdomen and of short duration seen mostly in children, the nausea type, the vomiting type, the gas type in which the gas accumulation is mostly gastric, and those in which there is intestinal disturbance.

**Habitual Constipation.**—In cases of habitual constipation from any cause, gastric symptoms are common. These comprise, mainly, nausea and vomiting, sensory gastric distress, and anorexia for the time being. The history of irregularity of stools, possibly alternating with a diarrhea, is most helpful in diagnosis. The other symptoms that are commonly present are: heaviness, sleeplessness, vertigo, headaches, nervous symptoms, continuous backache, and colicky abdominal pain, a feeling of localized pain in the sigmoid, the noting of impactions, slight fever, palpitations and irregularity of the heart's action. Gastric hyperacidity is most often the result of chronic constipation and not the cause.

**Enteritis.**—These comprise the cases of acute inflammatory diarrhea, such as enterocolitis and ileocolitis, and the infectious conditions of typhoid fever, cholera, dysentery, etc. In these the symptoms are mostly intestinal and general, although anorexia, those of irritation of the stomach (nausea and vomiting), jaundice, coated and dry tongue, abdominal distention and tenderness, and pains are common. In the chronic catarrhal forms, including colitis, the diagnosis is mostly made from the history, the stool examinations, the more strictly intestinal symptoms, and those of a general nature. Most cases of intestinal ulceration are accompanied by the history of syphilis, tuberculosis, acute or chronic infections, or constitutional or toxic diseases and cancer, the local involvement being suggested by the steady diarrhea and consequent general symptoms. The separation of cases of appendicitis from other forms of enteric inflammations need not be entered into here, and the diagnosis between appendicitis and gastric and duodenal ulcers is found in Chapter XX. The diagnosis of the acute and chronic colonic conditions are made mostly by fecal examination.

**Intestinal Obstruction.**—Intestinal obstruction due to ileus, occlusion, stricture, constriction, compression, incarceration, or strangulation may simulate the severe, primary gastric conditions in the first

hours or days as the case may be, but usually are diagnosable sooner or later by attention to special diagnostic signs pertaining to them. It may be mentioned that the chronic forms of obstruction are generally more confusing than the acute, and that in all obstipation, nausea, followed by vomiting of foods and then fecal matter, marked general abdominal distention, prostration and collapse are important abdominal symptoms.

**Peritonitis.**—Acute diffuse peritonitis, such as follows perforating ulcer of the stomach or duodenum, also develops from perforating typhoid or uremic ulcer, acute enteritis, infarctions, intestinal obstructions, appendicular disease, from perforation or traumatism of the colon; acute, phlegmonous, or gangrenous cholecystitis; rupture of the gall-bladder, rupture or leaking abscess of the liver, rupture of a suppurating mesenteric gland into the general peritoneal cavity, rupturing abscess of the pancreas, ulceration or rupture of the urinary bladder, suppurating and gangrenous ovarian cysts, pyosalpinx, and infections from the Fallopian tubes, or the uterus in puerperal cases. The attendant local and general symptoms of extensive inflammation, paralysis, septicemia, toxemia, etc., need not be considered here.

The cases of acute circumscribed and the chronic form of peritonitis may be extremely confusing in some instances. In the first, the vomiting, elevation of temperature, quickened pulse, local muscular rigidity and deep tenderness, tumor formation, leucocytosis, and differential blood-count are often helpful. These also pertain to the omental, perigastric, pericolic, strictly peritoneal, retroperitoneal, and subphrenic abscess conditions. In the chronic forms of peritonitis, which may be localized or diffuse, the history, the noting (either by medical or surgical means) of disease in special organs, like the genital organs, appendix, gall-bladder, etc., contain the main distinguishing points for the exclusion of gastric disorders. Tuberculosis of the peritoneum, the primary malignant and non-malignant tumors, hydatid disease, and secondary malignant disease need only be mentioned.

**Hemorrhoids.**—A functional hyperchlorhydria is sometimes met with in hemorrhoids. This, of course, must be brought about by a reflex from the irritable rectum. The majority of increased acidity cases with hemorrhoids experience no or but little relief in the stomach condition when the hemorrhoids have been removed, but now and then a case comes under observation in which only the removal of the hemorrhoids answers for success in the treatment of the gastric condition.

## DISEASES OF THE GALL-BLADDER.

The variability of the symptoms of cholecystitis and the frequency of cholelithiasis (5 to 10 per cent. of all necropsies), the close approximation of this organ to the pyloric extremity of the stomach and upper duodenum, the frequent existence of gall-bladder and gastric conditions, and the numerous cases of the latter in practice often make the clinical separation of conditions of these two organs a most difficult matter. This is truly unfortunate, because, practically, there are no two organs in the human abdomen in which means for making positive distinctions of separate organ disease would be more welcome. Almost daily cases of uncomplicated gall-bladder disease present themselves apparently as distinct gastric affections (generally of a reflex nature), and, on the other hand, certain gastric conditions, like the spasms and other nervous affections, look clinically like those of gall-bladder disease. In the majority of gall-bladder disease cases, diagnosis is possible by the noting of symptoms more distinctly referable to the gall-bladder or ducts, and only these will be enumerated.

**Cholangitis.**—Acute catarrhal jaundice usually follows in the wake of a gastro-intestinal catarrh of an acute nature, due either to dietetic indiscretion or alcoholism, or as an accompaniment to certain infectious diseases, such as typhoid fever, pneumonia, etc. If present, the onset of jaundice as a rule is slow and progressive, but, even before this is noticed, such symptoms as anorexia, bad taste in the mouth, coated tongue, foul breath, post-prandial epigastric distress, flatulence, nausea, and perhaps vomiting may have existed. The diagnosis is usually made on the appearance of jaundice, the bile in the urine, and the acholic stools.

The suppurative form of acute cholangitis is more difficult of diagnosis, although, when the constitutional phenomena, such as chills, fever, sweats, emaciation, diarrhea, jaundice, and the local phenomena of pain over the gall-bladder region, swollen gall-bladder, leucocytosis, differential blood-count, and enlarged spleen, be present, the diagnosis is suggested.

Chronic catarrhal cholangitis is usually suggested by rather constant disturbance in the region of the gall-bladder and relapsing attacks of jaundice. These cases often appear as those of chronic gastritis; in fact, the latter is probably the cause of the condition in most of the cases, excepting those due to biliary obstruction, the suppurative conditions, gall-stones, acute yellow atrophy of the liver, etc. The chronic forms of cholangitis are hardly ever diagnosed. There are no essential symptoms, and unless indications are obtained by the study of duodenal secretions diagnosis is only suppositional.

**Cholecystitis.**—The inflammatory conditions of the gall-bladder of a catarrhal nature may be considered as acute and chronic in character, both types usually being accompanied by a cholangitis. As we understand these conditions to-day, acute cholecystitis is due to bacterial infections (mainly typhoidal), and is important because the gall-bladder may become empyemic, ulcerated, or gangrenous, or the condition is so commonly the forerunner of gall-stone formation. Chronic cholecystitis may be a residual condition after an acute cholecystitis, may be chronic from the start, and clinically it is almost impossible to differentiate it from cholelithiasis, because chronic cholecystitis and cholelithiasis are often present at the same time, and if not, the symptoms of both are often identical.

The symptoms of acute cholecystitis are so variable and the stomach manifestations may be so prominent a feature in a case that difficulty in diagnosis is always encountered. Naturally, if following typhoid fever or long-standing bacterial conditions in the small intestine there is present an enlargement of the gall-bladder, this would lead one to the diagnosis, especially, if the gall-bladder is visible on X-ray examination. In these, a tenderness over the gall-bladder usually exists, with more or less constant epigastric distress and back pains, perhaps slight nausea, and the sensory gastric symptoms. When initial nausea and vomiting, fever, localized pain and tenderness in the region of the gall-bladder, spasm of the overlying abdominal muscles and enlarged gall-bladder exist, the diagnosis is easy. It is as these are separate in character and grouping from the true gastric conditions that differential diagnosis is made possible. Still, instances of both are common in clinical work, and here the complex diagnosis can only be made after extensive observation. Jaundice, as a rule, is not a part of uncomplicated cholecystitis.

**Cholelithiasis.**—The symptoms of gall-stone disease are: chronic recurring indigestion which resembles in clinical make-up hyperacidity or states of hypersecretion and chronic gastritis or chronic enteritis, but differs from these in the absence of the characteristic test-meal and fecal analysis, gall-stone colic (present in about one-half of the cases), followed by jaundice and deep tenderness in the biliary triangle, enlargement of the gall-bladder (40 per cent. of the cases); symptoms of obstructive cholecystitis, and the complications and sequels of cholelithiasis (pericholecystic adhesions, biliary fistulas, intestinal obstruction). When only one of the conditions exists differential diagnosis between the neurotic gastric conditions and atypical instances of gall-stone disease is most difficult, and can only be made by extended observation or surgery. In gall-stone disease hyperchlorhydria, simple gastralgia, and pyloric spasms are common resulting gastric conditions. No free acid

in the stomach is found in about 18 per cent. of gall-stone cases. An X-ray examination should be made, which in about three-quarters of gall-stone cases is positive.

**Biliary Carcinoma.**—Cancer of the gall-bladder and biliary ducts of a primary nature sometimes follows cholecystitis and cholelithiasis or long-standing indigestion of an obscure nature. When jaundice occurs it is generally chronic, the gall-bladder is enlarged, a tumor is palpable, and the general health is impaired. The cases when seen are usually well enough advanced for diagnosis, chronic or recurring jaundice being a prominent feature in the case. I have seen seven cases in which a tumor was palpable and other general symptoms were present, but the weight of the body had been sustained; this usually drops in all instances as the case advances. Excepting by means of surgery, early diagnosis of this condition cannot be made. A chronic cholecystitis or long-standing cholelithiasis in an individual over forty years of age should be considered as a cause for the development of carcinoma. Biliary adhesions binding down the gall passages may, by causing a chronic jaundice, simulate cases of biliary cancer; the distinction is usually made by the absence of the general symptoms of malignant disease, the long course of the disorder, the absence of local tumor formation, and traction upon the pyloric region of the stomach drawing it toward the under surface of the liver (observed by X-ray). Duodenal aspirations usually denote obstruction to the bile flow.

#### DISEASES OF THE LIVER.

**Acute Yellow Atrophy.**—The main symptoms in this disease are: gastro-enteric catarrh followed by jaundice, which deepens into a very dark yellowish or bronze-like skin; headache, mental confusion, restlessness, delirium, coma and perhaps convulsions; the gastro-intestinal symptoms of anorexia, coated tongue, nausea, vomiting, constipation, hematemesis, melena, hemoptysis; urinary and cutaneous hemorrhage; rapid, feeble and low-tension pulse; dilatation of the pupils; irregularity in respirations; and at first an enlargement and finally a diminution in the size of the liver. These cases at first simulate acute gastro-enteric catarrh accompanied by jaundice, or a cholecystitis, but as a rule the intensity and rapid deepening of the general and special symptoms lead one to the condition. Death usually occurs inside of two weeks, one-half of the cases terminating fatally between the fifth and tenth day.

**Perihepatitis.**—This is almost always a secondary disorder. The main symptoms are those of local pain of an acute nature, and audible

and palpable friction. Nausea and vomiting may occur in case the stomach, duodenum or gall-bladder be implicated in the inflammation.

General chronic perihepatitis, or "sugar-iced liver," is a rather uncommon condition and usually not diagnosed during life. Still, diagnosis is suggested when the following symptoms are developed: fullness, weight and pains in the upper abdomen; ascites, edema of the legs, transitory jaundice, and symptoms of chronic interstitial nephritis, arteriosclerosis, pericarditis, or pleuritis.

**Hepatitis.**—The symptoms here are those of liver pain and tenderness, nausea and vomiting, constipation or foul-smelling, loose movements, headache, restlessness, irritability, mental depression, disturbed sleep, sallowness of the general complexion, enlargement of the liver, urine of high specific gravity containing abundance of urates or uric acid and a trace of albumin, slight fever, chills or chilliness, anorexia, nausea and possibly vomiting.

The suppurative forms are the above with the symptoms of sepsis added, namely, septic temperature, marked chills, sweats, leucocytosis, and a greatly increased polynuclear leucocytosis.

Chronic interstitial hepatitis, or cirrhosis of the liver, may early in the case be mistaken for that of a chronic gastric or enteric catarrh. This is due to the fact that this stomach and intestinal condition often accompanies hepatic cirrhosis and the frequency of the symptoms of nausea, anorexia, eructations, vomiting, constipation, diarrhea, and epigastric fullness. Still, the history of chronic alcoholism, enlarged or contracted liver, mild jaundice, ascites, edema of the lower extremities, hemorrhages, evidences of the establishment of a collateral circulation, etc., usually establishes the diagnosis. Biliary cirrhosis, tuberculosis, syphilis, actinomycosis, carcinoma, sarcoma, benign growths and cysts, and hydatid disease of the liver should be mentioned and need not be entered into here.

#### DISEASES OF THE PANCREAS.

Cases of acute hemorrhagic pancreatitis are most liable to be diagnosed as intestinal obstruction of an acute type, but, in the first, stercoraceous vomiting and visible intestinal peristalsis are not present. Other cases again may be diagnosed as perforating ulcer in the upper abdominal zone or even non-perforating ulcer. In pancreatitis, however, the quick onset of symptoms and course of the disease, the digestive symptoms of severe nausea and vomiting, sudden pain of great severity located above the umbilicus and in the back; the marked spasm of the abdominal muscles accompanied with exquisite tenderness and

pain requiring enormous quantities of morphine to control it; symptoms of shock, constipation, or diarrhea; jaundice, leucocytosis, glycosuria, the Cammidge test, and tumor formation will sooner or later lead one to the proper diagnosis. In the stage of gangrene, the fever (usually not present in the acute stage, but it is in one-half of the gangrenous), marked leucocytosis (18,000 to 33,000), and the presence of a tumor mass all following the history of the acute stage may be helpful. Suppurative pancreatitis, which may follow the acute hemorrhagic inflammation, or be a complication of pancreatic lithiasis, a pancreatic cyst or cancer, or bile passage or duodenal inflammation, and is usually more difficult to diagnose early than the more simple acute forms. This is mainly due to the more chronic course found in about one-half of the cases. In the acute cases and later in the chronic forms, the symptoms of sudden onset, intense pain, vomiting and collapse, early elevation of temperature, chills, sweats, leucocytosis, and differential blood-count and tumor would be helpful.

Chronic parenchymatous and chronic interstitial pancreatitis are very liable to be overlooked or diagnosed for gastro-enteric or metabolic affections. The reasons for this are the chronicity of the course, the few definite symptoms accompanying these conditions, and their common association with gall-stones, carcinoma or cirrhosis of the liver, arteriosclerosis and diabetes mellitus. Among the more definite symptoms that might lead to the suspicion of a chronic pancreatitis are: the existence of the above-mentioned conditions; a chronic history of nausea, vomiting, and epigastric pain; loss of weight and strength, fatty stools, and high loss of albumin from foods in digestion and resorption, glycosuria, and the result of examination of duodenal secretion in which a deficient starch conversion fluid is obtained. For the latter observation the method of the author is most useful.

**Pancreatic Calculi.**—This condition is diagnosable to a slightly greater extent than the chronic forms of pancreatitis. The most frequent symptom is pain,—steady, intermittent, or colicky,—located in the epigastrium and under the left costal margin in the mammillary line and radiating to the left side of the spine or to the left shoulder blade (in biliary colic the pain is on the right side near the umbilicus or in the median line; also this pain radiates to the right shoulder-blade and shoulder), passage of calculi following the attacks of colic, vomiting during the seizure, temporary jaundice, symptoms of diabetes mellitus, steatorrhea and azotorrhea.

**Pancreatic Cysts.**—These are diagnosed, as a rule, by the noting of a rounded, fluctuating tumor situated in the epigastrium, usually to the left of the median line. Small cysts are not palpable from without

and usually escape detection during life. Sudden disappearance of a cyst occurs from rupture into the peritoneal cavity. Pain is a most constant feature and may be present before the cyst is large enough to be palpable. The symptoms of pressure on the adjacent organs are: those of stomach distress after meals and gastric intolerance for foods, anorexia, vomiting, colicky pain, constipation, jaundice, ascites, and functional disturbance of the pancreas. Sugar in the urine may or may not be present; and loss of weight and strength are usual. The diagnosis of the condition usually lies between cysts connected with the other abdominal structures, echinococcus of the left lobe of the liver, distended gall-bladder, hydronephrosis, and abdominal aortic aneurism.

**Carcinoma of the Pancreas.**—Cancer and sarcoma of the pancreas are diagnosable only after considerable observation, the constant presence of glucose in the urine, positive Cammidge tests, the noting of an immovable, irregularly shaped tumor mass, chronic jaundice, symptoms of pressure upon superior mesenteric and splenic arteries or veins or upon the portal vein, the rapid fatal course including marked emaciation and cachexia, pain and the gastro-intestinal symptoms of distaste for food and aversion to meats, post-prandial gastric distress, eructations, nausea and vomiting, fatty or bulky stools, and involvement of the adjacent abdominal organs in the growth. Tuberculosis and syphilis of the pancreas need not be entered into here.

#### DISEASES OF THE KIDNEYS.

**Nephritis.**—Acute and chronic parenchymatous and intestinal nephritis are diagnosed by urine analysis and the special symptoms referable to these affections. Gastro-intestinal work should include a complete chemical examination of the urine in all cases. The stomach conditions that are met with in nephritis occur in the acute parenchymatous types; a decrease of gastric secretion both in the hydrochloric acid and enzymes and a hyperchlorhydria in interstitial nephritis; hypermotility, gastric catarrh, nausea, and vomiting in the frank acute form, and in the chronic forms, anorexia, post-prandial distress, flatulence, coated tongue, occasional feelings of nausea, and possibly vomiting, thirst, and diarrhea. Amyloid disease of the kidneys usually follows long-standing suppurations or tuberculosis, and the urinalysis and physical examination of the kidneys, liver, and spleen are usually helpful in suspecting the presence of this condition. The pyogenic affections, such as pyelitis, ascending pyelonephritis, and hematogenous and traumatic infections, are diagnosable best by urinalysis and the constitutional symptoms.

Perinephritic abscess and the ureteral conditions need not be included. Acute dilatations of the stomach are occasionally seen in eclampsia. Gastric symptoms are among the most common early symptoms of nephritis. In cases with obscure gastric disturbances the chemical examination of the blood has been found very valuable. Several cases are reported in which the estimation of the blood creatinin not only showed that the patients were suffering from severe nephritis, but gave a fatal prognosis. In some of the early cases the blood uric acid was of value as an early diagnostic sign.

**Tuberculosis of the Kidney.**—This disease rarely causes confusion with the gastro-enteric affections. It may be suspected in acute miliary tuberculosis when oliguria or albuminuria suddenly develops. In the primary infections, the disturbances of urination, the examination of the urine (particularly the noting of the presence of tubercle bacilli), cystoscopic examinations of the bladder, ureteral orifices and ureters, the local swelling and pain, the constitutional symptoms, fever and rapid pulse are important matters. The gastro-intestinal symptoms are usually late and consist mainly of anorexia, diarrhea, and bulimia. Tumors of the kidney need not be included.

**Renal and Ureteral Calculi.**—Instances of this condition may be mistaken for the other kidney conditions, disease of the spine, colic, and gall-bladder or pancreatic calculi. The diagnosis is made by exclusion, the character and radiation of the pain during the seizure, the passage of bloody urine, anuria, and the X-ray.

#### DISEASES OF THE HEART AND ARTERIES.

These are diagnosable by the many symptoms pertaining to these structures of the body. Secondary chronic gastritis is common in advanced heart conditions, and at these times the test-meal analysis usually attests an achylic stomach, particularly when the heart compensation is lost.

**Arteriosclerosis.**—Gastro-intestinal symptoms are, at times, found in patients who have a generalized arteriosclerosis, or in those in whom the splanchnic arteries are solely or mainly affected. Among these are: abdominal pain of a paroxysmal nature lasting for a few moments and coming at various times each day; dull, aching soreness and throbbing in the abdomen (symptoms that are increased on exertion); abdominal distention and belching; fullness and distress after meals; occasional nausea, vertigo, and an achylic stomach due probably to the waning of gastric secretion incident to age as well as to the local interference with the circulation. The diagnosis is made by the

examination of the arteries, the maintained high arterial tension, and the noting of the cardiac and renal conditions that usually accompany general arterial disease. When sclerotic changes markedly affect the abdominal vessels the clinical picture is many-sided—at times resembling the gastro-intestinal neuroses, at others simulating organic disease. The patients usually present marked weakness, loss in weight, distaste for meat, attacks of abdominal pain, often occurring paroxysmally and at night, and belching and flatus. The most characteristic clinical phenomena are the attacks of severe abdominal pain in the epigastrium and about the umbilicus, usually from two to three hours after a heavy meal, gripping and twisting in character, lasting from one to two minutes, accompanied with a sudden rise in blood-pressure, and fear and anxiety on the part of the patient. The diagnosis should not be difficult, and to my mind the main support of the correct diagnosis should be based on the frightfulness of the pain, the short duration of the same, the occurrence of the pain in arteriosclerotic individuals, usually advanced in years, in whom, apart from the arteriosclerosis, there can be found no appreciable sign of disease. Men are said to be more frequently affected than women.

The differential diagnosis must, in some cases, be made between abdominal angina and other diseases associated with gastric crises. Here it may be stated that Allbutt believes that epigastric angina is but a somewhat aberrant form of ordinary angina, and due, broadly speaking, to disease of some part of the thoracic aorta; but in angina "more definitely abdominal," he thinks it may be due to disease of the lower portion of the aorta or in other large vessels there. Osler is disposed to discredit the diagnosis, regarding abdominal angina as but the abdominal symptoms of angina pectoris.

Sixty-four per cent. of chronic dyspepsia in old people is due to disease of some vital organ beyond the digestive tract, the remaining 35 per cent. is due to progressive degeneration of the secretory structures within the digestive canal.

**Functional Cardiac Conditions.**—In the first instance certain of these may be mistaken for gastric disease, but the history and the noting of the special symptoms usually make the case plain. Among such as I have seen that have come under observation for gastric conditions are tachycardia, bradycardia, arrhythmia, angina pectoris, and pseudo-angina, but all of these, excepting when some primary gastric condition was also present, have no special grouping or featuring of gastro-intestinal symptoms to warrant delineation.

**Microcardia**, a term used by Adler to denote the presence of a congenitally small heart, should be mentioned. The syndrome occurs in

males as well as in females, although it appears that females are more predisposed. As a rule, there are no subjective symptoms on the part of the heart. Very rarely there was a complaint of slight palpitation or some shortness of breath on moderate exertion. The symptoms most often complained of are due to irregularities of the nervous system, either of the peripheral nervous system, or else of the psychic sphere, or of both. Usually the patients belonging to this class complain of stomach trouble. A close study of the history will nearly always disclose the fact that they have suffered more or less gastric distress as long as they can remember. They show all those disturbances which are commonly attributed to hyperacidity and the formation of gas, and which so frequently pass under the name of gastritis, intestinal fermentation, etc. Examination of the stomach contents after a test-meal commonly shows a greater or less degree of hyperacidity, or rather of hyperchlorhydria, but no signs of ulceration or of any other organic lesion—simply the purely nervous form of excessive acidity. So, too, careful and repeated examination of the feces shows nothing abnormal, notwithstanding the continuous complaint of gas formation and distress from distention of the intestines. The diagnosis is made by orthodiascopy, the X-rays, and careful percussion of the heart.

**Endocarditis.**—In many instances of disease of the mitral and the aortic valves, mainly when regurgitation exists, a chronic gastritis, an anachlorhydria or gastric atony are present. Examination of the heart as a general routine is necessary in all abdominal cases, for the treatment of a disorder in the heart or lungs often clears the gastric symptoms.

**Myocarditis.**—The chronic forms of myocarditis not infrequently are accompanied with symptoms that bring the cases under observation for gastric conditions. Among such gastric symptoms are epigastric fullness, weight or pain ascribed to an indigestion, and post-meal distress of a sensory nature. The history, examination of the heart, etc., usually disclose plain signs of myocardial origin in each case.

**Pernicious Anemia.**—The weakness seen in this disease is commonly accompanied or preceded by nausea or vomiting, anorexia, and sensory disturbances. Diarrhea or constipation may also be present, and gastric analysis usually shows a subacidity, anacidity or achylia. High albumin loss of the foods is common in consequence. Examination of the urine often shows a marked indicanuria, in about one-half of the cases albuminuria, and this with casts in about one-fourth. The diagnosis, of course, is made by the examination of the blood, a clinical procedure that never should be neglected in any instance of anemia.

**Chlorosis and Secondary Anemia.**—These conditions are easily diagnosable on the appearance of the patient and the blood examina-

tion. The gastro-intestinal symptoms that are commonly present are: morbid appetite or anorexia, nausea and vomiting, distress after eating, flatulency, constipation, and palpitation of the heart. These to a less degree are also seen in instances of secondary or symptomatic anemia from any cause. In chlorosis the largest number of cases have a subacidity, only a small proportion having an increase of secretion. But a strange feature, as Liwschitz has shown, is, that with the low secretion a decided increase in gastric motility generally exists. Gastrophtosis is a common association with chlorosis. The following list, representing the number of milligrams of iron contained in 100 grains of the dry substance, is appended for assistance in the dietetic treatment of these cases.

PERCENTAGES OF IRON IN PARTS.

White bread .....	1.4	Potatoes .....	62
Apples, sweet .....	1.7	Green peas .....	68
Apples, sour .....	2.1	French beans .....	85
Pears .....	2.2	Carrots .....	89
Cow's milk .....	2.3	Lentils .....	93
Goat's milk .....	2.5	Asparagus .....	105
Brown bread .....	2.5	Yolk of egg .....	183
Red currants .....	3.6	Green chicory .....	220
Rice .....	4.5	Cabbage .....	305
Barley .....	4.7	Spinach .....	400
Black grapes .....	5.8		

**Leukemia.**—The gastro-intestinal symptoms of this disease are usually seen late in the course and as a rule are not prominent features. Among these are nausea, vomiting, and flatulency. Occasionally a diarrhea is early and obstinate. The observation, blood and physical examinations seldom lead one astray in the clinical forms of this disease.

In Hodgkin's disease and splenic anemia, the chronicity of the disorder, enlargement of the lymph glands, splenomegaly, anemia—consisting of a moderate reduction in hemoglobin and both the red and white cells—hematemesis, pigmentation of the skin, and jaundice are the main diagnostic points. The gastro-intestinal symptoms are those due to the anemia and the chronic constitutional effects on the system. As a rule, the latter are not prominent features in the case.

Angioneurotic edema as a cause of abdominal pain should be mentioned. I have seen several of such cases which have baffled most of the clinicians. Of course unless one has a history that is suggestive (and they practically all are) diagnosis would be quite impossible or at best only suggestive.

**DISEASES OF THE LUNGS.**

**Tuberculosis.**—Symptoms in the digestive canal are present sooner or later in almost every case of well-established tuberculosis. Sometimes the gastro-intestinal and the general symptoms are manifest before those of the respiratory tract, and not a few incipient cases are seen in which the chest examination is negative, in so far as definite physical signs are concerned, but in which the gastro-intestinal and general conditions are well established. Among these may be mentioned coated tongue, a persistent anorexia in a person in whom the appetite had always been good, post-prandial distress, eructations, nausea with or without vomiting, gastralgia, a possible gastric hyper-acidity in the early course of the disease, from loss of general body tone a myasthenia with submotility that later is liable to develop into a distinct atony of the stomach, enteralgia; constipation, possibly alternating with diarrhea, but a more steady diarrhea or tendency to loose movements later; catarrhal enteritis, symptoms of colonic ulceration, and afternoon fever of low degree. As a rule, the gastro-intestinal symptoms are controlled with difficulty unless the disease causing their production had been recognized and improvement had been made in the general way. Possibly the most unfortunate cases of pulmonary tuberculosis are those in which anorexia and gastric distress after the ingestion of foods are marked features in the beginning of the disease. I have often observed, in fact it is the rule, that in such individuals the foods cannot or will not be taken in sufficient amounts, and thus the prognosis for recovery is always poor. Other cases are seen in which appetite is a feature of prominence, and in these (when seen early enough) and those in whom an appetite can be worked up or at least sufficient amounts of food are taken, the results of treatment are generally better. Pulmonary tuberculosis causes a definite downward progression in both motility and secretory function of the stomach from the very beginning of the disease. There is a distinct tendency toward the formation of a definite clinical syndrome due to delayed digestion which becomes more and more associated as the disease progresses.

There probably is no more difficult problem in medicine than that of maintaining a high enough feeding in the first class of patients, or those who later develop marked anorexia and gastric distress of a sensory nature. In many of these it is as if the toxins of tuberculosis cause a hypersensitiveness of the stomach, and the parent disease, being essentially chronic or progressive, makes feeding doubly difficult. Still, it must not be forgotten that gastric analysis of a large number of cases in the early stage shows a normal or increased degree of gastric juice secretion, and

it is only when the disease is well advanced or mixed infection and fever exist that the secretory function diminishes. In any infectious disease a high fever for a short time or a low fever running for a length of time usually is accompanied with subacidity, an acidity or achylia. In tuberculosis too much attention should not be paid to changing the diet to meet the gastric analysis or the stomach symptoms. A much better plan is to change the forms in which the various articles of diet are taken, depending more upon those that can be given in a fluid, semifluid or finely comminuted form. These should be given at frequent intervals during the day, care being taken that those selected and their quantities should represent the highest caloric values in the smallest bulk, and that enough caloric units are given each day to more than maintain tissue equilibrium, the best standard being the highest tolerance of the individual. Hausmann has drawn attention to the fact that often in cases of incipient pulmonary tuberculosis, when no special or definite chest symptoms exist, examination of the contents of the morning fasting stomach will show the presence of tubercle bacilli swallowed during the night and making possible a diagnosis of the lung affection. I wish to add my confirmation to the value of these examinations, for in early cases I have observed the organisms in the empty stomach a number of times before cough and expectoration had developed. Thus the author believes that these examinations are of much clinical value.

Asthma, emphysema, hay fever, pleuritis, pneumonia, and other lung conditions are sometimes accompanied with gastro-intestinal symptoms, but these require no special mention here.

**Asthma Dyspepticum.**—Asthma due to digestive disturbances was first described in children under this term by Henoch. Since then other observers have drawn attention to cases of dyspeptic asthma in the adult. The cases are represented in those of periodic attacks of asthma at long intervals in which the attack comes on after some indiscretion in eating, drinking or the use of tobacco, and the more chronic and continued forms in which the attacks of asthma appear without cause. The respiratory attacks are distinctly different from those of true asthma in that prolonged expiration is not a marked feature, the seizures of difficult breathing (inspiration) are more intense, and the general symptoms of cold extremities, cyanosis, and collapse are more noticeable. Intense gripping, cardiac pains, like those in angina pectoris, may be present. The condition is probably precipitated by a hyperesthesia of the stomach (Boas), although, in my opinion, it is mostly due to pressure of the fundic end of the stomach (gaseous) lifting the right dome of the diaphragm and pressing the heart forward and the left lung upward and diminishing the capacity of the left chest. These same

attacks can be produced in some persons by over-inflation of the stomach. The conditions that are often present in these cases are gastric atony, gastrophtosis, hepatoptosis, hyperchlorhydria, low or absent acidity, chronic gastritis, constipation, and arteriosclerosis. Treatment directed to these conditions usually relieves and often cures many of the cases.

### DISEASES OF METABOLISM.

**Diabetes Mellitus.**—Not a few cases of diabetes mellitus first come under observation for the treatment of gastro-intestinal disorders. Among the conditions and symptoms that have been noted are: anorexia, bulimia or polyphagia, dry mouth, thirst, sensory gastric disturbance, gastrectasia from the enormous quantities of food and liquids taken, gastric catarrh, constipation, diarrhea and steatorrhea. The examination of the urine for glucose, etc. (a matter necessary in the handling of all gastro-intestinal affections), together with the other symptoms, such as polyuria, emaciation, sweet taste in the mouth, boils, carbuncles, gangrene, neuritis, etc., always discloses the proper diagnosis. As a rule, however, most of the cases of diabetes mellitus have comparatively little or no gastro-intestinal disturbance other than constipation, and it is often surprising that even in extreme types of the disease the gastric digestion remains good. This may be due to the acid bodies present in the majority of these patients assisting digestion, or to the glucose content in the blood and secretions inhibiting fermentation and putrefaction.

**Gout.**—In cases of acute gout, loss of appetite, flatulence, and the symptoms of gastric hyperacidity may be present. In the chronic or irregular forms alimentary disturbances are the rule. Among the symptoms and conditions noted are: psoriasis of the tongue, parotiditis and recurring pharyngitis, hyperchlorhydria and periodic gastrosuccorrhea, sensory stomach symptoms, low forms of acute gastric and enteric catarrh, constipation, acute colicky attacks followed by diarrhea, and increase of indican in the urine.

Instances of digestive disturbance in obesity, scurvy and rickets need not be treated here. States of indigestion are also common in the subacute and chronic forms of rheumatism, in arthritis deformans, Addison's disease, and angioneurotic edema.

### DISEASES OF THE UTERUS AND ADNEXA.

Reflex disturbances of the stomach are common in disease of the female internal generative organs and appendages. That the associa-

tion between the two organs is intimate is seen in the nausea, loss of appetite and bad breath during menstruation, the vomiting and craving for certain special foods during pregnancy, the gastric disturbances accompanying the menopause, and the common association of gastro-intestinal conditions with pelvic organ disease. During menstruation it is common to observe subacidity or an acidity, the normal secretion establishing itself after the first day or so. For this reason test-meals should not be extracted during this period. Kehrer has shown that in the first six months of pregnancy the gastric secretions are lessened, the condition sometimes continuing to labor, although the motility is generally normal. Following the loss of blood during labor, the digestive capacity usually is diminished for a few days. About one-half of the women at the climacteric have a gastric subacidity of a continued nature. Dysmenorrhea, retroversion of the uterus, cervical stenosis, chronic pelvic inflammation, menopause with atrophy uteri, salpingitis, parametritis, endometritis, endocervicitis, myoma uteri, and procidentia uteri may be combined with gastric symptoms. The following conditions and symptoms may be present: gastritis, neuroses of the sensory or secretory types, gastrophtosis, nephroptosis, coloptosis, mucous colitis, post-prandial distress, pyrosis, eructations, nausea and occasional periods of vomiting, distress or pain on pressure over the epigastrium or other parts of the abdomen, mucous stools and constipation. Most of these, however, are due to primary conditions in the digestive canal, and only influenced toward relief to the extent that operation or cure of the pelvic condition might improve the general body state and nutrition of the neural system. However, clinical experience will prove, in women who have marked gastro-intestinal symptoms and pelvic disease or disorder, that in more than two-thirds of them the gastro-intestinal symptoms are due to *bona fide* conditions affecting the alimentary canal, which are separate and apart from the pelvic condition.

#### DISEASES OF THE SKIN.

**Urticaria and Erythema.**—As is well known, these conditions are commonly due to absorption into the body of poisonous substances ingested with the food (lobsters, crabs, fish, tainted ice-cream, strawberries, canned foods). In cases of urticaria, even the recurrent type, it will commonly be found that a marked hyperchlorhydria exists while the skin eruption is present.

**Eczema.**—As Hyde has suggested, cases of eczema are often accompanied or produced by morbid affections of the digestive organs. To these, of course, the constitutional states, such as gout, chronic

rheumatic states, diabetes, anemia, etc., are added. The association between eczema and abnormal conditions of digestion has not been established, but that such a possibility of cause and effect exists is strongly borne out by results in the treatment of many of the dermatological affections. Before the eruption appears in herpes zoster and when the lower spinal nerves on the left side are involved, the cases may be mistaken for some of the various painful types of acute gastric disturbance; the same is true of right-sided "shingles" with regards to acute conditions of the liver and gall passages. States of chronic excessive putrefaction in the intestines are the commonest cause of chronic eczema.

#### DISEASES OF THE NERVOUS SYSTEM.

**Epilepsy.**—Gastric hyperesthesia, gastroparesis, gastric atony, and states of habitual constipation or fermentation are common associations with epilepsy. Cases are seen in which a violent gastric crisis occurs parallel to the epileptic seizure, the attacks occurring about two hours after a meal. In these, pain and intense nausea or vomiting may be present. An aura may be abdominal in location.

**Chorea.**—States of fermentation and putrefaction of the stomach contents have been described in a case of chorea by Ewald and Witte, in which they obtained from the stomach 250 cubic centimeters of a yellowish-brown, fetid, almost fecal-like stomach contents, and in which acetone was noted in the urine. One case, which at operation proved to be one of pyloric stenosis the result of ulcer, was relieved of the choreiform movements as well as the purely gastric phenomena by treatment directed to the condition of the stomach. States of tetany are much more common than choreiform seizures in the above-described stomach condition.

**Brain Tumors.**—Projectile, "purposeless" vomiting is met with in about 50 per cent. of the cases of tubercular, gliomatous, syphilitic, sarcomatous, cancerous, or cystic tumors of the brain. The bowels are usually constipated in these cases, and blindness and convulsive seizures exist. Simple morning nausea with vomiting of tasteless fluid which disappears during the day may be beginning symptoms of cerebellar tumor. As time goes on, the typical ataxia and symptoms denoting pressure on the fifth, sixth, seventh, eighth and ninth cranial nerves ensue. These, with retinal changes and exaggerated reflexes, suggest the diagnosis. Persistent vomiting, with pains in the abdomen, may precede the paralytic evidences of a hemiplegia some hours. These cases usually present doubts as to whether the rupture of the blood-vessel in the brain occurred consequent to the strain of vomiting, or whether a small

hemorrhage had taken place in the internal capsule, causing the vomiting in the first instance, and, the hemorrhage continuing, this being lost with the production of the paralysis.

**Locomotor Ataxia.**—Visceral crises, characterized by sudden attacks of paroxysmal pain in the gastric, laryngeal, renal, cardiac, rectal and genital regions, are often met with in this disease. Of these, gastric crises are by far the most common and may also be accompanied with vomiting and even hematemesis. It has been reported that hyperacidity of the stomach is the most common condition of secretion in *tabes dorsalis*. In the 9 cases in which I have made test-meal analysis (8 men, 1 woman), a normal secretion was found in 5, subacidity in 3, and hyperacidity in 1. Gastric hyperesthesia is decidedly more regularly seen, and, after the condition had been established for years and the bladder and rectal symptoms are present, atonic conditions of the hollow viscera of the abdomen are not uncommon.

**Neurasthenia.**—There is no condition or disease of the neural system that is more commonly accompanied by gastro-intestinal symptoms than neurasthenia. The mental, spinal, vasomotor states present in these cases, and the sensitiveness of the upper splanchnic area to constitutional conditions, make possible a great liability of gastro-intestinal symptoms in neurasthenia. Hardly a case of general neurasthenia is seen in which disturbances pertaining to the stomach or digestion of foods are not also present. Among such may be mentioned: distress coming on acutely after meals; weight, fullness, burning, pricking, hot and cold and squeezing sensations in the gullet, fauces, tongue, and lips; those of hyperacidity, pyrosis and flatulency after meals, tympanites, and constipation. Among the pathological conditions in the abdomen that may also be present are: prolapse of the various organs, hyperchlorhydria and gastrosuccorrhea, chronic gastric or enteric catarrh, myasthenia, atony or dilatation of the stomach or colon, and hyperesthesia gastrica, gastralgia and enteralgia. Quite obviously, as the abdominal symptoms of neurasthenia predominate over the corporal, the abdominal type of neurasthenia should be thought of first, and the cerebral, vasomotor, spinal, and urinary symptoms be looked upon as resulting or referred from the abdomen. On the other hand, should the symptoms be mainly corporal and but little or not at all abdominal, general nervous weakness should be thought of. Naturally, when the abdominal conditions mentioned are present, attention directed to them should always be given in the treatment of the case; particularly is this important in the abdominal types of the disorder.

**Hysteria.**—This functional disorder is commonly accompanied by symptoms referred to the digestive tract. Among these may be mentioned *globus hystericus*, *dysphagia*, hysterical vomiting, regurgitation of food without nausea or true vomiting and possibly persisting for months, aversion to and obstinacy in the taking of foods, depraved appetite, sensory gastric disturbance, flatulency, constipation, diarrhea, hiccoughing and peristaltic unrest of the stomach and reversed peristalsis of the intestine. The character and persistency of these and the other symptoms in spite of all forms of treatment usually make diagnosis easy.

## CHAPTER XXVIII.

### Nervous and Endocrine Disturbances of the Stomach.

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It may seem strange that the treatment and management of the neurasthenic individual should be presented in a work like this. Clinical experience proves, however, that instances of complex nervous disturbances are factors of considerable moment in gastro-intestinal work. The term "neurasthenic individual" is frequently applied to a conglomerate group of more or less unrelated conditions often made to include what unquestionably are mild forms of definite psychotic states, of hysterical conditions, and also the result of gross organic brain or nerve lesions as well, and states resulting from a disease or condition which has existed in a susceptible individual for a sufficient length of time. The term neurasthenia should be restricted to an enfeeblement or fatigue neurosis. Its cardinal characteristics are an inordinate sense of physical or mental fatigue, or both, a difficulty in concentration, of attention and application to work, a sense of pressure in the head and irritability of the spine, various paresthesias, and more or less disturbance of function of the various visceral organs, all being more or less closely related to psychogenic factors. The uniformity of symptoms is never distinctive or characteristic although it often does seem as though the essential symptomatology may be grouped about that of a purely psychic character. The so-called psychasthenic state is really a phase of and should be included under the term. It belongs to the broad borderline between mental health and disease and may be distinguished from many forms of psychoses only by the slighter degree of their manifestations. Jelliffe writes that "in the normal individual, even with the most grievous form of bodily suffering, the mind is preserved relatively intact, so that one is able to meet the trouble by the philosophy of reason and religion, but in the neuroses and neurasthenia, the mind itself is the seat of the pathologic disturbance, and the individual realizes that the conflicts taking place in his own mind are more or less at the root of the trouble." While it is questionable that overwork can deliberately bring on a neurasthenia in an otherwise healthy individual, it is nevertheless true that insufficient time for rest, insufficient sleep, days spent in feverish activity, evenings and Sundays in working out new plans,

all have been factors in bringing about the final breakdown. Conditions of great exhaustion are especially liable to follow certain severe physical diseases such as typhoid and influenza. In gastro-intestinal work it is found that in long-standing suffering from conditions, especially those of a toxic nature of the intestinal canal (because of the toxemia or the susceptibility of the individual or both together) the combination is important. Many neurasthenics connect their conditions with sexual irregularities or disturbances of the sexual functions, but this should not be rated very high as a causative factor, even where it has been carried out to an unreasonable degree. It is probable that these are manifestations of an underlying irritable nervous or psychopathic predisposition or the symptom of a graver incipient, psychic disorder. This is proven by the fact that these individuals do not suffer from a physical condition but rather from the mental conflicts which arise in the moral and spiritual life. Anything which may put a strain on the attention, both physically and emotionally, gives rise to nervous troubles. The use of such drugs as alcohol, opiates, coffee and so forth, probably also are factors in the production. Trauma is one of the most important causes, particularly where the question of compensation comes into consideration, or if the injury, in any way, has shocked the bony structures in which the central nervous system is confined. It is a well-known recognizable fact that the neurasthenic breakdown appears more readily when intense emotional disturbances are combined with unusual or excessive demands upon the physical powers. In the so-called constitutional neurasthenic or psychopathic constitution, general nervousness rests upon a congenital predisposition. In children of this makeup, improper or perverted education and training are often among the most serious injurious influences. Such factors as the unnatural forcing of some manifest talent, the stern, misunderstood rebuke or fear or anxiety, and the excessive pampering or yielding to selfish desires or whims, all play a part in laying the foundation upon which future trouble develops. Children of this constitutional makeup, as well as adults, are usually endowed with an increased or intensified sensitivity, hence are more strongly stimulated by ordinary impressions than the normal child. They have imaginative faculties markedly developed. Nowadays this is catered to by taking such children to improper theatres or moving picture shows to quiet them or satisfy their desires for entertainment.

**Symptoms.**—It does not require very close observation to recognize that many of the symptoms are due as much to physiological functional activity, improperly carried out, as to actual loss of function, occasioned by disease. Clinically the cases are grouped under the following divisions: (1) Cerebral. (2) Spinal. (3) Cardiovascular. (4) Visceral. (5)

Urogenital. (6) Traumatic. (7) General. Of this grouping about 13 per cent. come under the cerebral group, 45 per cent. under the cerebro-spinal, about 28 per cent. gastro-intestinal. The other 14 per cent. are divided up between cardiovascular, traumatic, etc. In practically all cases an inordinate sense of fatigue, both physical and mental, is the dominating feature; the slightest exertion is soon interrupted by a disproportionate feeling of fatigue, regardless of the character of the work performed. This abnormal sense of fatigability tends to render their attention more easily distracted, thus impairing their ability to concentrate and developing a loss of confidence in their capabilities. These are factors which develop indecision, uncertainty, inconclusiveness, pessimism, emotional irritability, depression, loss of emotional control, doubts and fears of various kinds, painful thoughts, and impulsive and obsessional ideas. In all neurasthenics, during some period of their illness, sleep is more or less impaired. Because of the insomnia there develops mental distress, anxiety, and fear. These patients complain of various disagreeable and distressing sensations in the head, such as numbness, pressure, constriction, emptiness, fullness, bursting and so forth, leading to more or less aching and often definite pains.

In the spinal group there is always more or less aching, pain, paresthesia, or localized tenderness along the spine, particularly over the cervicodorsal, lumbar, and coccygeal regions. These are particularly liable to appear in the patient with hysterical tendencies. Associated with this condition, one frequently finds various paresthetic disturbances in the extremities, such as numbness, burning, tingling, itching and pressure pains.

In most individuals there is more or less disturbance in the cardiovascular system. The rate of the heart is often accelerated although there may be retardation. Often there are intermittency, pounding or flopping sensations, and sometimes definite pains assuming more or less the character of anginal attacks. In the respiratory system, one frequently finds superficial breathing or shortness of breath, a tendency to sighing respiration, and at times symptoms resembling hay fever or an asthmatic attack.

Gastro-intestinal symptoms due to neurasthenia and psychastenia are very common. They range all the way from erratic appetite, perhaps a desire for excessive amounts of food without satiety to complete anorexia. Gaseous fermentation with its secondary pressure effects: bloating, belching, nausea and vomiting, symptoms of pyrosis, various types and degrees of pain in the epigastrum or throughout the abdominal cavity, constipation, diarrheal attacks, and mucous discharges are some of the more common conditions complained of. Many of these

symptoms are no doubt due in part to the secretory and motor disturbances resulting from an impairment of the nerve regulation. But they are also due to the peculiar anatomical makeup, since many of these patients show a marked tendency to a ptosis of one or more of the abdominal viscera. The author desires here to record that in his gastro-intestinal work as case after case comes along in which the final conclusions warrant the diagnosis of one of the forms of chronic excessive intestinal putrefaction, an irregular nervous phenomena is common, and among his more wealthy patients a third of the large number have had sanitarium experience for the treatment of functional nervous disorders, when these disorders were secondary to an intestinal condition, which when cleared away have rendered the individual entirely free of even any tendency to neurasthenia or psychasthenia. There is no doubt in his mind that this whole subject is very largely bound up in toxemia from the intestinal canal. Neurologists should accept this as a cause. They should because it is the commonest of all. If they would add wise and scientific attention to biologic errors in the intestinal canal to such treatments as they carry out on their patients, the results from the treatment of neurasthenia would generally be tremendously improved.

**Treatment.**—These patients require such a great deal of attention to listen to their complaints, to educate them systematically toward health, and to combat the autosuggestion that they have, that it hardly falls within the possibility of the average clinician, who is not a neurologist to cope with the individual. The first essential is the winning of the confidence of the patient. Without that confidence a physician will not be able to reach the fundamental sources or underlying causes, since most of these patients feel that their condition is not understood, and fail to express openly fears and thoughts that are fundamentally responsible for much of their distress, and this often leads them to direct attention to other features in order to avoid having them revealed. As far as the patient is concerned, in the acute condition, absolute rest, both physical and mental, is necessary. Just how to bring this about, can only be solved by a careful study of the makeup and personality of the individual patient. As a rule, it is required to take the neurasthenic individual out of the environment in which he lives and separation from the family and from the petty annoyances of everyday life may be necessary. It has been well said that a healthy physical, intellectual and moral environment is an essential factor, not only in the prevention but also in the cure of psychoses and neuroses, because it tends to strengthen and develop the mind and body, the deliberation, judgment, and the higher controlling functions of the brain.

The regulation of the diet may also be most important. From the time with certain gastro-intestinal conditions, the diet taken is that sufficient would be in order. Particularly is this true in those suffering excessive intestinal participation. Diet and treatment will be found in the volume on Diseases of the Intestines such as vines. Liquors and strong tea and coffee, should be avoided. They may be used in moderate quantities—once a day. Foods should be soft and simple. Massage especially in the weakly, should take the place of more active muscular exercise.

In the more chronic states, graduated methodical exercises including respiratory ideas and activities are to be preferred. Hydrotherapy and electrotherapy also have a place as therapeutic measures, but in selective. Given indiscriminately, they usually do much more harm than good, since when no benefit is derived they only serve to impress deeply upon the mind of the patient the hopelessness of the case. Wet sheets, baths of various kinds, cold rubs, salt rubs, hot and cold showers, douches and sponges all have their place. Drug administration must be determined mostly by the character and intensity of the disturbances manifested by the different organs of the body. Drugs are frequently required to lessen the nervous restlessness and tension which is almost constantly complained of. Perhaps small doses may suffice and it would be in order if they did but large doses often required. I have never seen any good come from the use of opium or mix. veronica. Sleeplessness, as a rule, is best combated by longed hot baths or spinal hot douches. Hot packs might suffice. Hypnotics are required it is found that veronal, trional, sulphonal, chloral remedies are serviceable. They should be used in preference to more active remedies, such as paraldehyde, chloral, and morphine.

The gastro-intestinal disturbances nearly always require relief of the distress and to regulate the impaired functional action. The selection of these remedies one must be guided not only by the general conditions, as well as the reaction of the individual particular remedy used.

The question of climate, when a change of environment as is advised, is also of importance. Generally speaking, a dry, sun-bright country has been found to be the most beneficial, especially in winter time. The seashore is usually too sunny and where there is a great amount of sun, the individuals are rendered more nervous in consequence. Psychotherapy when required can be best carried out under medical care, with its supervision and management. Matters per organotherapy are presented later on in this chapter. As a final note the author advises that in all gastro-intestinal work particularly, no

Neurasthenia or psychasthenia or neuroses should ever be made on any individual coming under the attention of the reader unless every possible effort is made to establish another than a neurological diagnosis of a functional disease. Unless this is the cardinal rule one is very likely to make a diagnosis of neurasthenia or psychasthenia and do gross injustice to an individual. While much has been written upon these conditions, and the author is willing to admit the justice of an opposite opinion, he holds it as a principle in clinical work that the diagnosis of neurasthenia or psychasthenia should never be made. We may use the term asthenic or psychasthenic individual. Whenever these are suggested, let us make to find causes for the condition other than those which most physicians consider ample. I would rather fail in the handling of a few of these individuals than to fail in the vast majority by considering that such states as neurasthenia or psychasthenia as entities exist, and when conditions are noted to feel that they are always secondary to some general condition, which if removed would be more helpful to that individual than the long length of useless, time-taking treatment, everlasting expenditure of words and money these people are made to endure, but any results worth while being brought about.

#### ENDOCRINE DISTURBANCE.

In recent years considerable interest has been manifested in digestive disturbances caused by irregularities in vagal or sympathetic innervation. It has been made to classify hyper- or hypo-tonic states in one way rather by taking more or less apparent clinical entities and designating them as etiologically due to nerve disorders. The more experienced and conservative workers hold quite firmly to the older classifications, while others look definitely upon conditions such as hyperchlorhydria and hypermotility as excitation states of the vagi, and lowered tension, functional atony and motor insufficiency as tonic states of the sympathetic. A close analysis of cases seems to suggest that, while both are right in individual instances, the proper attitude is to believe that these disturbances occur most often for reasons outside of the nervous system alone, but that clinical conditions can occur which are essentially disturbances in nerve-tone alone, and are best handled by classification along these lines.

Very little definite is known of the innervation of the digestive system. It is a complicated automatic system sensitively affected by changes of the emotional sphere of the brain, general states of the body as well as the rise and fall of body functions that takes place each day in health. Viewing these conditions from the clinical standpoint

of digestive disorders, experience has suggested that hyperchlorhydria is rarely met with, and, if so, it is a very transitory condition, and that distinct hypersecretion is always based upon definite pathology. Sub-acidity and an acidity are more commonly encountered, although nowhere near as frequently as are normal states or those caused by pathology. Those cases that are due to nerve-states, however, are also transitory in type, the anacidic ones more so than subacidic. Many diagnoses of an acidity, even achylia, as well as subacidity, are made that are due entirely to fear of the passing of a stomach-tube to extract a test-meal, and individuals may become "dyspeptic" from worry, fear and grief, as well as anxiety. It is probable that the conditions described as heterochylia, polysymptomatic neurosis, gastralgokenosis, nervous anorexia, nausea, hypermotility and eructations are essentially neural disturbances. While I am aware that sudden emotional shocks can bring about an acute cessation of gastric digestion, motor as well as secretory, my belief is that most all of the deficient motor disturbances are pathological, these being brought about in most instances by toxic effects on the sympathetics of the stomach (as well as the intestines), these toxins being derived from the intestines and elsewhere in the body.

It is most probable that the good effects brought about by the use of atropine in hypersecretions is partly due to the well-known inhibitory effect of this drug on the branches of the vagus, the benefits of strychnia in slight gastric atony to its tonic effect on the nerve, and the benefit that many of our gastric cases accrue from a rest and change to the effect that these have in neural inhibition and benefit on the general tone of the body.

Becoming dissatisfied with the term "vegetative" used by the Viennese school instead of "autonomic" for the entire system of ganglia and nerves and end-organs and amplifying the subject beyond propagandic teachings of Eppinger and Hess following divisions of this part of the nervous system are now accepted:

1. Midbrain autonomic division, consisting of the cells with their axons which emerge from beneath the superior corpora quadrigemina supplying the iris and ciliary muscle.
2. Bulbar autonomic, of which the fibers emerge from beneath the floor of the fourth ventricle to pass out with the seventh nerve, nervus intermedius, ninth and tenth nerves, to supply the vessels and glands of the mouth, pharynx, nose, esophagus, stomach, small intestine, part of large intestine, trachea and lungs.
3. Thoracic autonomic, or sympathetic cells of the lateral portion of the anterior horns of the spinal cord from the first thoracic to the fourth lumbar segments, and passing out by the white rami to the ganglia

cord and its connections to supply the skin, arteries, muscles, glands, abdominal viscera and internal generative organs.

4. Sacral autonomic, leaving the cord from the first to the third sacral segments as the pelvic nerve, to the ganglia of the anus, rectum, descending colon, bladder, urethra and external genitals.

It is now believed that there is an autonomic reciprocal activity between the brain and the viscera of the various organs. Functionation here is largely controlled by various stimulants derived from the internal glands of the body. Maybe it is best for therapeutic purposes to assume that the endocrine disturbance is the cause of the phenomena of disturbance in the vegetative nervous system known as vagotonia or sympatheticotonia.

This leads us to a branch of medicine much discussed at the present day, many of the writings upon which are worthless. However, there is some reason to believe that a gland may become over-active in an effort to compensate for a deficiency of functions elsewhere in the endocrine-gland chain, and that an intimate relationship of glandular function exists so that hyper-activity is a compensatory effort to off-set hypo-activity elsewhere.

It is not the purpose of this volume to enter a long presentation on the endocrinology pertaining to all of medicine. Rather I shall present what may be called glandular types of individuals comprising, thyroidal, adrenal, pituitary, parathyroid, thymus and gonadal, asking the reader to remember that combinations of these types are not uncommonly met with. These in manifestations and symptoms are presented in classical types in the following subdivisions:

#### THYROID STIGMATA.

##### Symptoms of So-called Hyperactivity.

Exophthalmos	Scanty and frequent menstruation
Wide palpebral slits	Emaciation
Tachycardia	Periodic loss of flesh and strength
Nervousness	Mild hyperthermia
Tremors	Increased basal metabolism
Stellwag's sign	Lymphocytosis
Von Graef's sign	Eosinophilia
Anginoid attacks	Increased coagulation time
Hyperidrosis	Increased emotional irritability
Deformities of the nails	Ideas of reference and persecution
Dryness of the mouth	Manic symptoms
Excessive salivation	High hair line
Vomiting attacks	Skin, blond, clear and smooth
Diarrhea	Premature old age
Hourglass contraction of the stomach	
Irregular breathing	
Teeth well formed, white and clean	
Thyroid skin line pink or red	

## Symptoms of So-called Hyposecretion.

Precocious graying of the hair	Scanty eyebrows (outer $\frac{1}{3}$ )
Drowsiness	Cold, bluish, moist hands
Anorexia	Tendency to chilblains
Small stature	Irregularly developed teeth which decay easily
Puffiness of the face	Defective development
Sallow complexion	Dry, thick, scaly skin
Scanty hair	Acrocyanosis
Deep set eyeball	Localized transitory edema
Dull and listless cornea	Urticaria
Hard, brittle nails	

## PITUITARY STIGMATA.

## Symptoms of So-called Hyperactivity.

Greatly thickened nose	Increased interdental spaces
Prominence of superciliary ridges	Enlarged sella turcica
Tendency to increased tufting of terminal phalanges	Hypertrophied, thickened skin
Coarse, heavy, overhanging eyebrows	Hypertrophied nails
Protruding thick lips	Short, square hands
Prominent hypertrophied lower jaw	High carbohydrate tolerance
Teeth separated and spaced	Amenorrhea
Feminism in male	Visceroptosis
	Increased sugar tolerance
	Giantism (anterior lobe)
	Musical, acute sense of rhythm

## So-called Deficiency Symptoms.

Adiposity	Slow pulse
Fat pads around the mal- leoli	Sluggish mentality
Increased development of the mammary glands	Mononucleosis
Deposits of fat around the buttocks and the neck	Eosinophilia
Alabasterlike skin	Leucocytosis
Irregular menstruation	Short stature
Subnormal temperature	Childlike voice
Wide intercostal angle	Bitemporal headache
	Supraorbital headache
	Fatigability
	Sterility
	Infantile uterus

## ADRENAL STIGMATA.

## Symptoms of So-called Hyperactivity.

Aggressive type of individual	Masculine type of female and vice versa
Increased growth of hair on body	Prominent canine teeth
Teeth show dark spots or markings	Eyebrows meet in midline
	Skin pigmented
	Tendency to hyperchlorhydria and hypertension

## Socalled Deficiency Symptoms.

Fatigability  
Pigmentation  
Sargent's white line

## THYROID STIGMATA.

Sparse eyebrows  
Tall, lethargic mentality  
Characteristic pyramidal  
pubic hair in males and  
flat in females

## Symptoms of Socalled Hyperactivity.

Menorrhagia or metrorrhagia  
Teeth, tortion, disproportion

## Symptoms of Socalled Hyposecretion.

ophic testes	Infantile uterus
cretion	Nervous constipation
ia	Deficient lateral incisors
hea	Sterility
	Absent lateral incisors

## THYMUS STIGMATA.

stature	General glandular enlargement
al arch	Abnormally long thorax
oiglottis	Visceroptosis
osis	Eosinophilia
v pitting	
phaticus (various degrees)	

## PARATHYROID STIGMATA.

t cramps	Tetany with associated symptoms
of the hands	

## PINEAL STIGMATA.

(Occur only in children.)

astro-intestinal work endocrine therapy is a matter of consider-  
portance. Four out of ten people in the office and clinic show  
egrees of suprarenal deficiency. In controlling the symptoms  
per-thyroid case endocrine knowledge is important. Commonly  
of the indolic and mixed forms of chronic excessive intestinal  
balance in the endocrine system is met with. This probably is  
xic depressing effects upon the suprarenals and requires admin-  
of this gland substance for the relief of the symptoms. Where  
, total or partial, of gastro-intestinal symptoms in women is

due to menopause, the use of ovarian substance, or extract of corpus luteum (sometimes with pituitary substance and suprarenal substance) is well worth while. The author recommends that these glandular substances be used in smallest doses possible. Ofttimes one can accomplish by very small doses better results than could be brought about with massive ones. Polyglandular therapy need only be mentioned to be condemned. It is as unscientific in this connection as is polyvaccine in instances of systemic infection. The author also suggests that the clinician should acquire knowledge of endocrinology as a factor of importance in the therapy of gastro-intestinal conditions. My experience has been that the cases are very few in which the use of one glandular substance or any combination of them will absolutely control the symptoms which bring the patient under observation, although it occasionally happens. What is more important in this connection is that it is a supporting and an additional method of therapy which often helps to bring better results about. Nowadays clinicians are required to have a practical knowledge and ability to make a socalled endocrine diagnosis as well as knowledge of the therapy of the subject. The author desires to record that clinicians should be careful to use gland products which have potencies. There are many in the American market today that are absolutely useless.

## CHAPTER XXIX.

### Functional Disturbances of the Stomach.

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#### DISTURBANCES OF SECRETION.

##### HYPERACIDITY AND HYPERSECRETION.

###### Classification of States of Excess Gastric Juice Secretion.

Hypersecretion of gastric juice, represented both in the conditions designated as hyperchlorhydria or gastrosuccorrhea, is a symptom of some form of irritative stomach disorder. It should be looked upon as a symptom to as much an extent as edema is recognized as a symptom of renal, cardiac, or blood disease, or a cough or expectoration is of disease of the respiratory tract. The sooner this is generally observed the better it will be for a fuller practical understanding of what are the commonest of all demonstrable gastric conditions. In this volume a functional distinction is made in the types of excessive secretions that may exist; the term hyperchlorhydria representing a too high secretion of gastric juice occurring only during gastric digestion, the stomach being alkaline or neutral in the interval, and the term gastrosuccorrhea representing a more continuously high secretion during gastric digestion and persisting to a less extent when the organ is empty of food. The latter form is divided into two arbitrary forms, namely, *gastrosuccorrhea periodica* designating that form in which the total clinical course of the condition is short, and *gastrosuccorrhea chronica* referring to the form in which the condition is continued over a length of time. In clinical work it is not possible to divide the different degrees of hyperacidity or hypersecretion in a definite way, and assign all cases as positively belonging to one of the three types. Assuming the cause of increased secretion to be irritation, insensible clinical gradations from one state into another are seen. That is, first there is hyperchlorhydria, then *gastrosuccorrhea periodica*, and finally *gastrosuccorrhea chronica*. These cannot be considered as separate diseases or distinct clinical conditions, but rather degrees of hypersecretion which in severity follow in the order mentioned. Further, hyperchlorhydria has been understood as

an abnormal secretion represented by the gastric juice containing an increased amount of hydrochloric acid in the unit of quantity, whereas gastrosuccorrhea, or hypersecretion, is understood as a quantitative change in the amount of gastric juice, the relative proportion of hydrochloric acid in a given amount of gastric juice being normal or above. These latter distinctions, however, are not always practical for the reason above stated.

Boas, Strauss and Zweig class some of the cases of increase in the quantity of gastric juice during digestion as hypersecretion, the pathognomonic feature being an empty stomach in the fasting condition. Undoubtedly a number of such cases exist, but they are hardly more numerous than those of a simple nature (hyperchlorhydria of a dietetic type) in which more or less acid content is found in the fasting stomach. Furthermore, is it not reasonable to believe, in the cases in which the fasting stomach is free of acid, that the secretion of, say, twice as much gastric juice of a relatively normal acidity is nevertheless not a digestive hyperchlorhydria. What practical difference in the diagnosis of secretory conditions is there in making clinical distinctions between instances of 50 cubic centimeters of filtrate from test-meals with a hydrochloric acidity of 60°, and 100 cubic centimeter returns having an hydrochloric acidity of 30°? None that I can see excepting as to motor activity. What concerns us in this connection is the total amount of hydrochloric acid and enzyme that is secreted during gastric digestion, and the chemistry of the stomach in the interval. My opinion is that the element of gastric motility has not received the degree of attention in the diagnoses of states of increased secretion that it deserves. In the close analysis of many cases in which the diagnoses of hyperchlorhydria and gastrosuccorrhea looked reasonable, it was found that the motility of the stomach was as much and often more responsible for the high acidity or the large gastric juice return as were states of the secretory apparatus itself. The fact is, there are two opposite and still associated conditions that influence gastric chemistry, namely, the states of secretion and the states of motility. For instance, a hypermotility may exist with an increased secretion and still the test-meal analysis in respect of acidity be normal or even subnormal; a hypomotility may exist with a normal secretion and still the test-meal analysis be that of hyperchlorhydria and even gastrosuccorrhea; and a mechanical pyloric obstruction or spasm may exist and still the test-meal analysis be that of normal or states of increased secretion. Assuming that we accept the established clinical divisions and also consider motility,

how are we to differentiate degrees of departure from normal in clinical work?

The return of an Ewald meal from a normal stomach should give between 20 and 70 cubic centimeters of filtrate, with a free hydrochloric acid of 20 and 30 degrees, and a total hydrochloric acid between 50 and 60 degrees. A hyperchlorhydria usually gives between 50 and 100 cubic centimeters of filtrate of the same or higher hydrochloric acid acidity, the stomach being practically empty of food at the second hour after the taking of the meal, and always neutral or alkaline in another hour's time; such a return may also be seen in slight degrees of myasthenia with or without a hyperchlorhydria. A gastrosuccorrhea usually gives over 100 cubic centimeters of filtrate of a relatively high

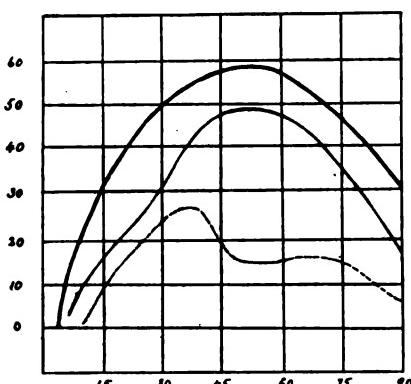


Fig. 144.—Course of acidity of the gastric juice following an Ewald test-meal of a roll weighing 40 grams and one and a half glasses of water. Black line represents the total acidity. Red line, the free hydrochloric acid. Dotted red line, the combined acids.

hydrochloric acid acidity, the stomach not being practically empty at the second hour, the acidity then being about one-half that of the foregoing, and following this a more or less constant acidity even when the stomach is empty after meals and in the mornings; in primary atony and dilatation, or secondary atony of a benign type, the same findings would be noted, excepting that food retention would be more of a feature, and thus the mixed-meal diet methods of examinations would be necessary to make detailed observations. Although the old classifications are now quite useless, they answer for the purpose of presenting the symptomatology of this varied subject along some definite lines and thus will be retained.

A simple and still most practical way to diagnose and express the status of acid secretion of the stomach is to use a single figure to express

the total acid in the Ewald test-meal. Considering amounts up to 90 cubic centimeters of unfiltered gastric content as the normal quantity upon extraction, about 60 cubic centimeters will represent the quantity of fluid when it has been filtered, and it is therefore evident that a unit of the filtrate represents a higher acidity than the same amount of the unfiltered test-meal would have, since the starch substance left on the filter paper, being solid, has a low standard of acidity as compared to the fluid that has run through. It is very practical for the purpose, however, to figure the acidity of the whole return, for this would express the acidity present in the stomach when food is being digested, and the plan I employ and would advise is the following: The total return is measured, then the acidity of a filtered portion is obtained, and the total acid secreted is estimated on the basis of the total return. For instance:—

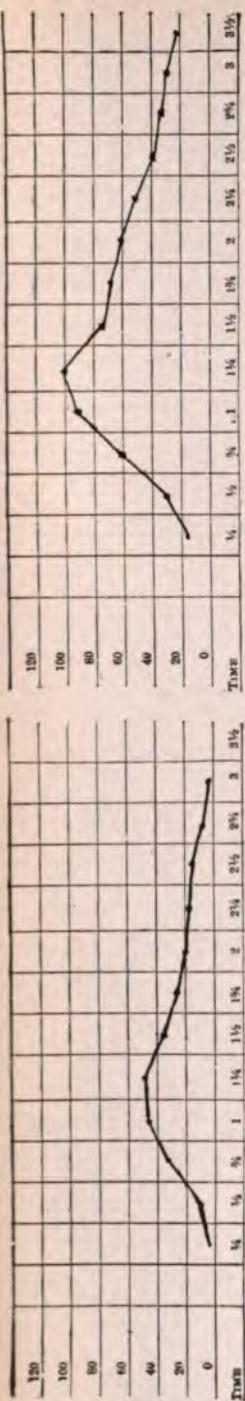
Total return .....	90 c.c.
10 c.c. of filtrate contains	{ 30 degrees of free hydrochloric acid 30 " " combined " " 10 " " total acidity

The total hydrochloric acid would then be 60. This figure is multiplied by the total return 90, giving 5.400, which is the expression of the total hydrochloric acid of that test-meal.

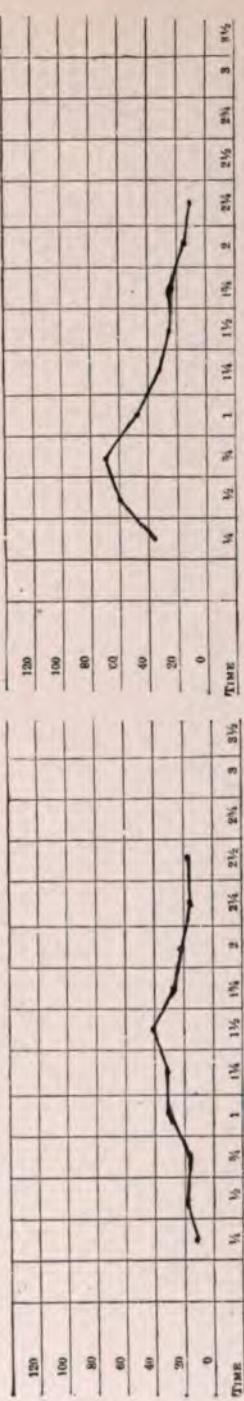
After several thousand estimations on this basis I have placed the figure 5.000 as the expression of the acidity that should not be exceeded. If exceeded, it is conclusive of a higher than normal hydrochloric acid content of the stomach. This plan of estimating assumes that the stomach had been emptied at the time of the test-meal extraction, which is always accomplished by means of the author's test-meal bottle. If this plan were more generally employed, cases of disturbances of motility and pyloric stenosis would not so often be diagnosed as errors of secretion. The free HCl figure would be 2.500.

Since the advent of the Rehfuss tube and fractional methods of extraction it has been found that the normal stomach commonly contains gastric juice in the fasting state, in amounts of from 30 to 120 cubic centimeters. Studies with this method show that various normal stomachs secrete differently, and to gain an accurate idea of the functional factors in connection with the disturbances of secretion this method is recommended. Plates XCI and XCII illustrate the three normal types of secretion—namely, isosecretory, hypersecretory, and the hyposecretory. These are illustrated at the top, the abnormal types being below them.

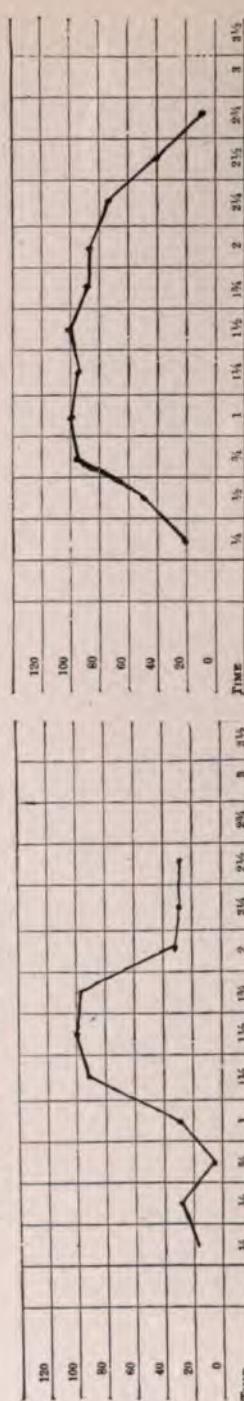
PLATE XCII.



### (1) Isosecretory Type (Normal).



## (2) Hypersecretory Type (Normal).



#### (4) Early Hyperacidity.

(c) Dietetic Hyperacidity (Simple).

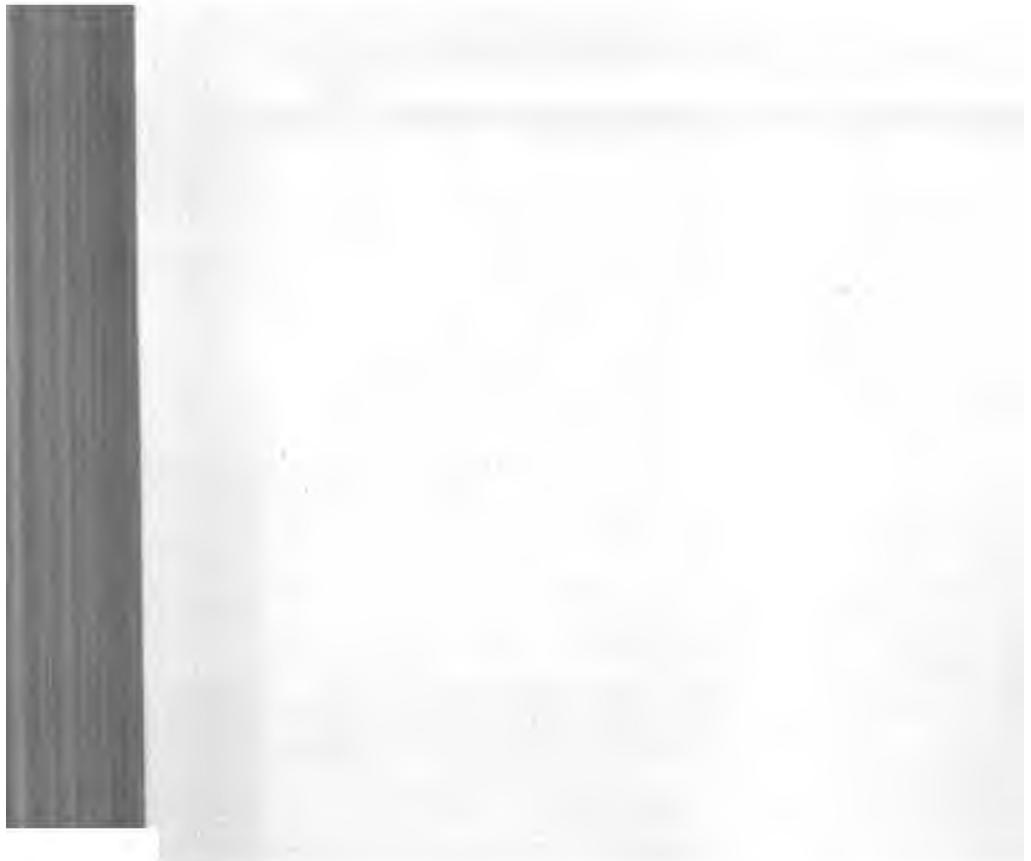
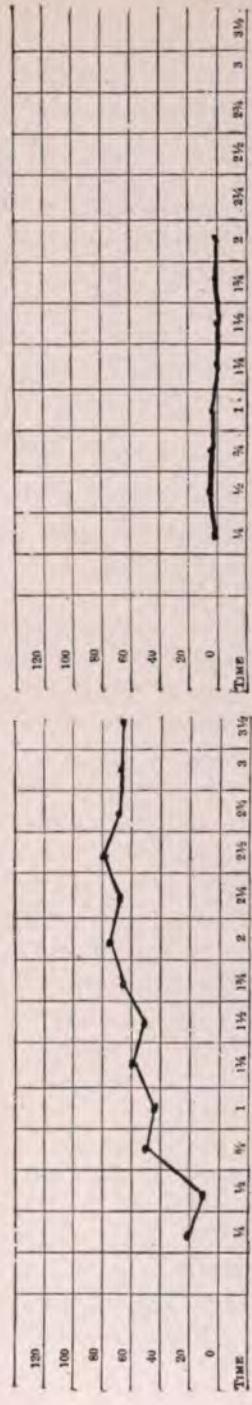


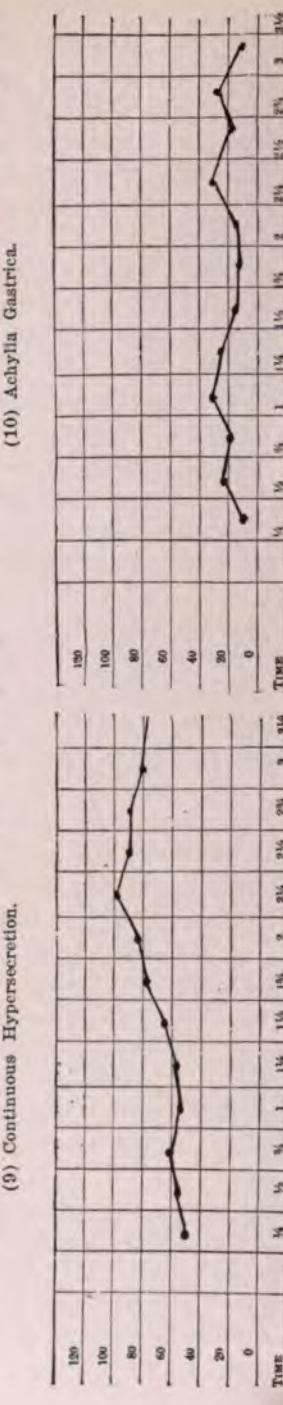
PLATE XCIII.



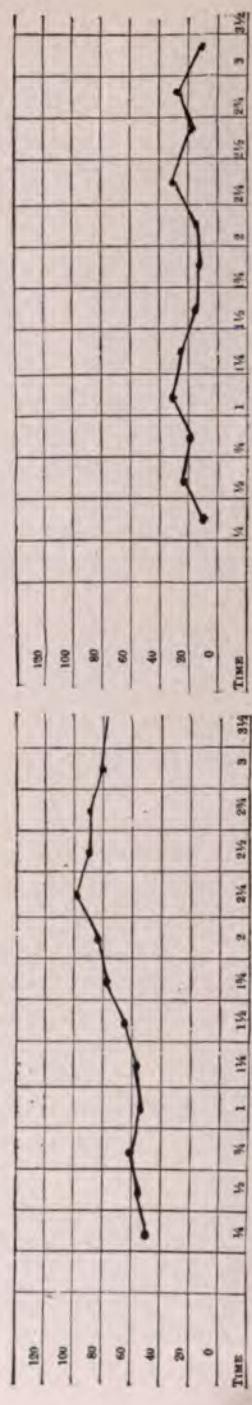
(7) General Neurosis.



(8) Vagotonia.



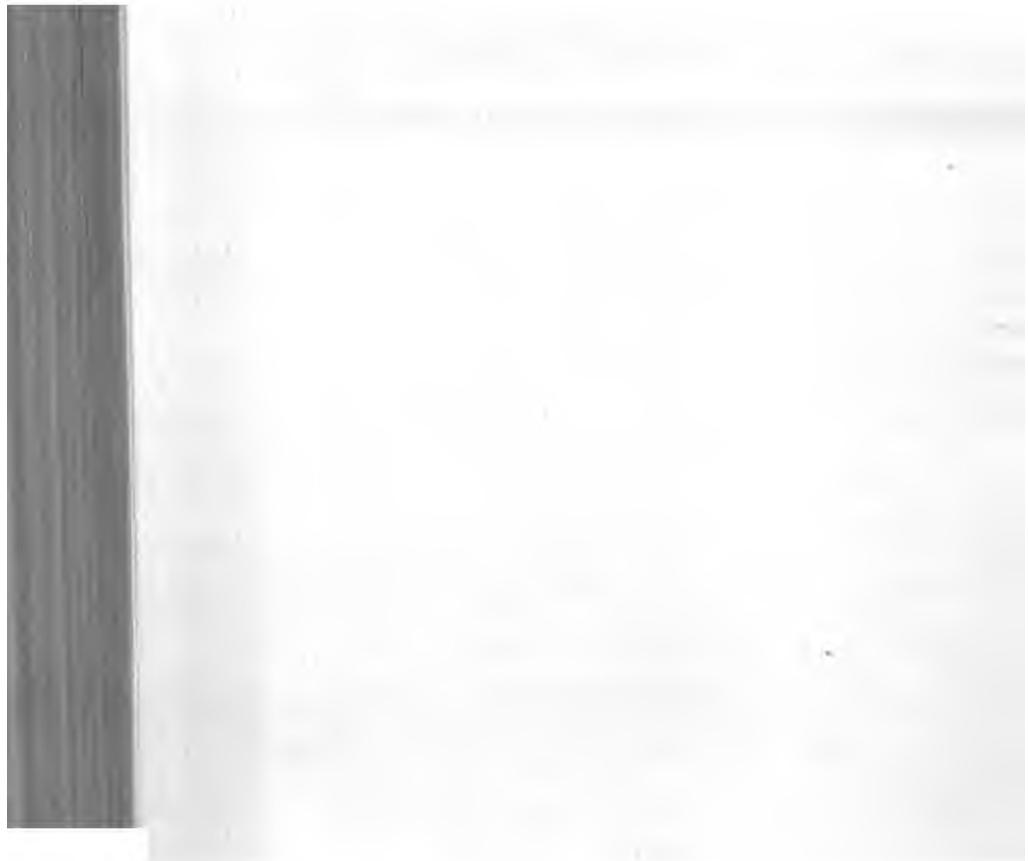
(9) Continuous Hypersecretion.



(10) Achylia Gastrica.

(11) Pyloric Stenosis.

(12) Gastric Carcinoma (Early).



**ETIOLOGY AND PATHOLOGY.**

**Hyperchlorhydria**, or hyperacidity of the stomach, is the most frequent of all gastric disturbances, seen in about one-eighth of all gastric conditions. The affection is observed in the young and middle aged, and not so frequently in the old. It is said to be found more frequently among the better and wealthier classes than among the poor, but of this I have my doubts if we can consider dispensary patients as poor. Of 560 patients in private practice suffering from digestive disturbance the diagnosis of hyperchlorhydria was made in 171 (30 per cent.), and of 170 in dispensary work the diagnosis was made in 298 (42 per cent.). The fact, as Jaworski has pointed out, that the condition occurs with great frequency among the Polish Jews may account for the comparative highness of the last figures. Although, in my opinion, the factor of neurosis may be equalized between the two sets of patients, that of improper or poor feeding was decidedly more prominent in the clinic patients. Among the Jewish races the commonest gastric neuroses are those of sensory types. No anatomical lesions are demonstrable in cases of simple hyperacidity. The following factors are important in its production:—

1. Disturbances in the secretory apparatus of the stomach due to mental states. These are noted in cases of mental strain, mental over-work, anxiety, worry, hysteria, neurasthenia, melancholia, and certain psychic conditions. From the works of Pawlow<sup>1</sup> and Cannon<sup>2</sup> we have learned of the intimate relationship that exists between states of the mind and secretion and motility of the gastro-enteron. From these and clinical observations it is logical to infer that any quick or sudden mental shock may bring on states of low or absent secretion or motility, and when these are continued over a length of time (mental strain) the very opposite may occur in the secretion, the motility at the same time remaining normal or even being depressed.

2. Indiscretions in diet, such as the use of irritating, too bulky foods, the continuous taking of too large meals, the abuse of alcohol, coffee and tea and particularly that of tobacco, hasty eaters, drinkers of too hot or too cold fluids or carbonated beverages particularly with the meals, foods that are too highly seasoned with condiments or heavy users of garlic, chives, or onions, and those who eat much candy or are frequenters of the soda-water counter.

3. Primary myasthenic or atonic states of the stomach are given as causes. As to whether these should be considered as etiological factors of hyperacidity I have my beliefs. The study of states of secretion in the cases of primary types of atony from all causes certainly does definitely warrant this association. I believe too that the

connection is also apt to be the reverse—that is, first a long-standing hyperacidity and then the resulting atony. Normal and low gastric secretions are very common with atony and the former are not always transcending states from hyperacidity as might be caused by a chronic gastritis.

The same holds quite true in so far as constipation from intestinal or gastro-intestinal atrophy is concerned. This form of constipation is chronic, and in these cases states of high gastric secretion are by no means constant features. It is more regularly seen in acute constipation, which most often is accompanied with gastric hyperacidity for the time being, and the chronic forms with a normal status of secretion. In other cases, again, constipation should be looked upon as a result of the hyperacidity rather than the primary cause. In the saccharobutyric and mixed forms of chronic excessive putrefaction in the intestines, hyperacidity is a common finding, but in these cases it is only a symptom of the intestinal condition.

4. Symptomatic hyperacidity due to open, more or less healed, or irritative scars from acute or chronic ulcer, early stage of gastric carcinoma and possibly all through malignant degeneration of an ulcer where the cancer formation is mostly extragastric, cholelithiasis, pancreatic and renal calculi, acute hepatitis, chronic appendicitis, mild degrees of acute gastritis, gastritis acida and chlorosis.

**Gastrosuccorrhea**, or hypersecretion of gastric juice, has been described in three forms, namely, digestive gastrosuccorrhea, gastrosuccorrhea continua periodica, and gastrosuccorrhea continua chronica. The etiology of these are decidedly more frequently pathological than neurotic. It may be said that the proportion of pathological cases increases as we pass from the digestive hyperacidity through the form of chronic periodical hypersecretion to the chronic continued forms.

Digestive or alimentary gastrosuccorrhea was first described by Strauss, who has devoted much study to the subject. This author draws distinct attention in this condition to the presence in the stomach of an unusually large proportion of fluids as compared with the solid contents, and warns against mistaking states of motor insufficiency for it. Boas, Elsner and others have more or less confirmed his observations. The condition occurs more frequently in males, and usually in young and middle-aged persons. According to Strauss, the disturbance is probably mainly due to abnormal irritability of the secretory apparatus. It may be looked upon clinically as a more pronounced hyperchlorhydria and a sort of intermediate condition between true hyperchlorhydria on one hand and states of distinct gastrosuccorrhea on the other. The same etiological factors mentioned under hyperchlorhydria enter into the production of this disorder.

Gastrosuccorrhea continua periodica comprises the next step in the pathogenesis of these conditions. In this, as in gastrosuccorrhea continua chronica, a more or less continuous flow of gastric juice exists even without the stimulus of the ingesta, excepting that in the first the condition lasts for from three days to two weeks and occurs abruptly, whereas in the second the flow of gastric juice continues over lengths of time.

It is about at this phase in the clinico-symptomatological aspect of these conditions that the dietetic and neural factors which enter into the production of excessive secretion give way in prominence to truly pathological conditions. Still, that the mental and dietetic factors that were mentioned under hyperchlorhydria must also be recognized as causative elements seems

to be proved by a number of prominent observers, but certainly not to the extent or in the num-

ber of cases that they are in the more simple conditions. It may be about at this point in the development of these conditions that some serious disturbance with the hormones or a long-standing irritative or dietetic condition, causing possibly an increase in the number of parenchyma cells of the gastric glandularis, comes in for consideration. A number of these cases have been presented in the literature, and the presentation and argument of their etiology leave much to be desired in the way of clearness.

Strauss lays special stress, in the production of the periodic and chronic forms of gastrosuccorrhea, upon retention and irritation of foods (such as may be noted in pyloric spasm and gastrophtosis) as exciting causes. However, since the advent of abdominal surgery,

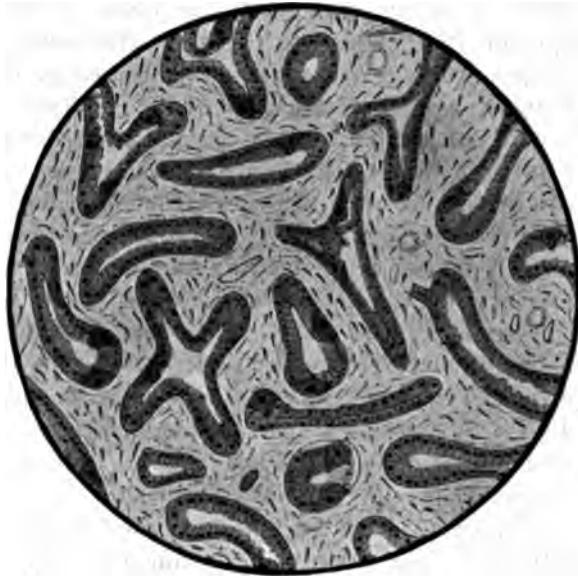


Fig. 145.—Drawing of a microscopic view of a piece of mucous membrane, removed by stomach-tube, from a case of hyperchlorhydria chronica. The specimen shows particularly the increase of the cellular elements and hypertrophy of the glandular tissue.  
X 400.

there is no doubt that even with the periodic form possibly a third of the cases have as causative factors those mentioned in divisions 3 and 4 under hyperchlorhydria.

Gastrosuccorrhea continua chronica, or Reichmann's disease, must be considered as the highest development of excessive gastric juice secretions. In this type the simple factors (mental, dietetic, etc.) give way to distinct and pathological conditions, prominent among which are states of gastric ulcer; gall, pancreatic, or kidney stones, and chronic appendicitis. Added to these are the instances of pathological conditions in the gastric mucosa, mentioned by Hemmeter<sup>3</sup> and Strauss,<sup>4</sup> in which a proliferation of all of the glandular elements of the stomach occurs and particularly the oxytic or border cells. Of such instances I have obtained specimens from several cases, and these conditions must still be considered as non-surgical in character. Surgery has shown that mostly all of these cases are those of pyloric stenoses due to ulcer, only a small number being due to a pure neurosis. Of the later of the intermittent form associated with migraine, tabetic crises, hysteria, etc., excessive stimulation of the gastric nerves from the central nervous system figures as a cause. Crohn and Reiss<sup>4a</sup> classify the cases as: (1) Organic disease of the stomach, particularly ulcer (intrinsic origin). (2) Organic disease of associated abdominal organs (reflex action). (3) Hyperirritable conditions of the cerebral or autonomic nervous system, both organic or psychic (extrinsic origin).

Strauss, in an argument against motor insufficiency or simple retention of secretion being insufficient for the development of hypersecretion, draws attention to the fact that hypersecretion can exist without motor disturbance, and in those in whom motor insufficiency existed after the disturbance in motility had been removed, the symptoms of hypersecretion persisted for days and weeks before it disappeared. Also, that under rectal nutrition—therefore when local stimulus from the stomach contents was entirely absent—the amount of secretion obtained from the empty stomach was just as profuse as during the time when food was introduced by mouth. For these reasons he considers the nature of continuous hypersecretion to be a persistent irritability of the secreting parenchyma of the stomach, which of itself may be due to a number of causes. This author concludes that from what has been learned from Pawlow's investigations it hardly appears remarkable that hypersecretion may be of neurogenic origin. Future investigation will most probably show that the great majority of cases of chronic hypersecretion have a distinct pathological basis, either in the stomach itself or elsewhere in one of the various internal organs, particularly those in the abdomen, and it is further my

belief that the causes which will remain reasonable for lesser states of increased gastric juice secretions will have a very small place in the majority of cases of gastrosuccorrhea of a continuous nature. Sou-pault, who operated upon 28 cases of typical gastrosuccorrhea, in each instance found an ulcer at the pylorus. Ewald also believes that cases of gastrosuccorrhea, formerly regarded as a true neurosis, are still always to be regarded as consequences of an ulcer running a latent course. Of the cases of undoubted chronic gastrosuccorrhea I have had operated upon because they did not respond to medical treatment, 64 per cent. were due to ulcer, about 33 per cent were reflex from disease in other abdominal organs, and the remainder were neurological. It is important to add that hypersecretion is chiefly a disease of middle life and is more frequent in countries in which ulcer and hyperacidity are common than in other regions. As has been pointed out several times, a gas result of two per cent. or over from the fermentation of the neutralized test-meal is of much clinical value in distinguishing the surgical cases.

#### SYMPTOMS.

**Subjective.**—In the main, the symptoms of all of these affections are alike, a few differences being noted in the higher types as compared with hyperchlorhydria. As a rule, the subjective symptoms appear gradually and consist of eructations of acid gas or regurgitation of acid fluid or food, heartburn, pain and burning in the stomach or cardiac region, severe stomach pressure or pains coming on one or more hours after meals and relieved by the ingestion of albuminous foods, such as milk, meats, and eggs, and the taking of alkalies or water, or made worse on starchy diets, attacks of vomiting of the stomach contents during the height of gastric digestion, the return burning the throat and numbing the teeth as it passes over, thirst or excessive flow of saliva, nausea, constipation, anorexia, malaise, headache, loss of weight and strength, and finally the development of general neurasthenic symptoms. Acute gaseous distention of the stomach at the height of the acid saturation of its contents, or when the stomach is empty, is, in the first instance, suggestive of hyperchlorhydria, and in the second of gastrosuccorrhea.

In the taking of the history several most important points should be noted. If the duration of illness has been brief, or if the stomach distress comes on at the time the foods are saturated with acid (one or two hours after eating a simple meal) and are less or absent when the stomach is empty, the diagnosis of hyperchlorhydria is suggested. If the patient gives a history of having recurring attacks over a length of time and intervals of entire relief in the interval, the diagnosis of a digestive

or chronic periodic gastrosuccorrhea of the primary or secondary form is suggested. If the history of gastric distress is continuous over long periods of time, and the symptoms of distress are present when the stomach should be empty of foods, such as during the night or early morning, the diagnosis of gastrosuccorrhea chronica is suggested.

**Objective.**—The diagnoses are made by the analyses of test-meals and the noting of the chemistry of the stomach in the interval. The physical examination of the patient is often negative, although it is usual that in cases of slight disturbances of secretion the individual looks to be in a good state of general health, although he may be a trifle anemic; whereas those who have hypersecretion of the marked forms, more or less loss of weight and more marked anemia are noticeable. Examination of the abdomen may display a tenderness or sensitiveness on pressure in the epigastrium or over the stomach, and the manifestations of an atonic or slightly prolapsed organ. A diminution in the chlorides and an increase in indican are frequently observed in the urine.

It is interesting that a distinct symptomatology may exist without confirmation in test-meal findings. This puts much inconsistency in the subject, for on the one hand higher acid values than heretofore are considered normal (Rehfuss) and on the other a clinical hyperacidity may not show in test-meals. There is no doubt about it that much has yet to be learned about this entire subject, in which subjective symptoms are quite as valuable and often more so than objective ones. I agree with Boas and others that the diagnosis of excess and secretion is far from as simple a matter as was believed in the past. The fractional test-meal method offers by far the best means in an objective way, still even here high acid values may be met with, with more or less continuous secretion in the empty stomach and yet the conditions of secretion be normal for that stomach. This again brings the clinical side forward as of much importance, to which may be added their relief by administration of alkalies.

It must be remembered that the fractional method of test-meal examination provides much information in designating the type of excess secretion and occasionally suggestions of etiology which the Ewald does not give. The author recommends the fractional method as routine procedure in gastric analysis. The Ewald method is detailed, however, because some clinicians have not the time to employ the other, and occasionally in gastric work it answers. On the subject of hyperacidity the reader is referred to the acid charts found in this volume, they describing conditions better than words can.

The Ewald test-meal and stomach analyses of the various types show the following:

*Hyperchlorhydria.*—A poorly digested Ewald meal, a little larger in quantity than normal (total bulk up to 120 cubic centimeters and filtrate never above 100 cubic centimeters); a relatively high acidity for the quantity returned, the unit in a certain amount usually being about or over 30° of free hydrochloric acid, and 30° of combined hydrochloric acid (the main feature is the amount of free hydrochloric acid above the saturation of food, for a normal stomach should not give an excess acidity above 30° in not more than 50 cubic centimeter filtrate), a poor digestion of the starch content of the test-meal, a practically empty stomach two hours after a mixed meal, and an alkaline or neutral stomach after this until food is again taken. The acid index is above 2.500 for the free HCl, and 2.500 more for the combined. The total index may be as high as 8.700. A larval form has been described by Strauss in which the height of acid secretion may be at thirty minutes after an Ewald meal and ninety minutes after the mixed. In these the symptoms of hyperacidity are present, but the test-meals must be extracted earlier than usual to make the diagnosis, for at sixty minutes after an Ewald meal the contents may show a subacidity.

*Digestive Gastrosuccorrhea.*—The same as above, excepting that the total quantity of return and acidity is higher, the filtrate running to 100 cubic centimeters or above, and, while there is no food in the stomach after meals as above stated, a moderate amount of fluid contents of an acid nature may be obtained in the interval persisting for hours. The morning empty stomach in these cases should be neutral or have only the slightest acidity, and during the attacks the mucous content may then be high. The acid index is generally higher than in hyperchlorhydria.

*Periodic and Chronic Gastrosuccorrhea.*—A large quantity of chyme extracted after a test-meal of the same food character as in the above two conditions (excepting more fluid than either), running as high as 200 cubic centimeters and giving over 100 cubic centimeters of filtrate with a relatively high acidity, the stomach after the second hour of a simple test-meal or the sixth hour after the mixed meal still returning a fluid in acidity almost as high or higher than test-meals extracted from a normal stomach in the height of digestion, a continuation of gastric juice secretion independent of the ingestion of foods (usually a thin, highly acid, straw-colored chyme), and a persistently acid morning stomach before food has been taken.

#### PROGNOSIS.

In all cases of acute hyperchlorhydria the prognosis is good. In the long-standing types the prognosis is favorable, about 75 per cent.

becoming clinically well on persistent dietetic treatment. The other 25 per cent. are the protracted cases and make up the proportion in which the gastric condition is symptomatic of a pathological condition situated elsewhere in the body (usually within the confines of the abdomen or pelvis). Riegel, Kaufmann and Steels believe that it is impossible to permanently reduce the secretion of acid. Concerning this I wish to state that if care is taken in these diagnoses and only uncomplicated cases of hyperchlorhydria are dealt with, the secretion can be reduced in by far the largest proportion of cases providing the patients remain long enough under observation and stringently follow instructions. The acid content of the gastric secretion when increased by dietetic or mental stimulation can more positively be reduced than can the low secretions be increased in many of the non-pathological cases (of course, this excepts the acutely suppressed secretions due to emotional or psychic causes). Of such instances of hyperacidity as I have kept close records of, most of the cases were relieved not only in a sensory way, but also in regard to the constant outpouring of the secretion. My experience has been that the majority of the individuals cease giving attention to the condition when a degree of relief from the irritative symptoms is obtained, the latter of which is possible in almost all of the cases. In digestive gastrosuccorrhea the results from treatment are almost as good, there being only a slightly larger proportion of incurable cases. In the periodic form of chronic gastrosuccorrhea the results in the way of cure are not so good as in either of the above unless a primary curable cause is discovered. Much can be done, however, in increasing the intervals between the attacks and controlling the symptoms when they are present as well as keeping the patients comfortable in the meantime. Continuous chronic gastrosuccorrhea is not curable by medical means in the largest proportion of cases, surgery giving a much larger percentage of cures. If a condition of primary atony exists and can be benefited, the prognosis for substantial relief is not so unfavorable, although even here relapses are common. Pyloroplasty and gastro-enterostomy offer the best results in secondary atony, and to these must be added the operations upon other organs in the abdomen, such as those for gall-bladder, renal and pancreatic stones, appendicitis, and anatomical obstructive conditions in the colon. At least one-half of the cases require surgery for cure, medical measures only being capable of relief for the time being.

#### TREATMENT.

**Dietetic.**—In the treatment of hyperacidity and the alimentary form of hypersecretion diet occupies the first and all-important place. The treatment of the periodic and chronic forms of hypersecretion

primarily is that of the treatment of the underlying cause, and in these the diet occupies only a secondary importance. The all-important plan of the diet is that the foods, in character, form or quantity, should produce as little irritation to the mucosa of the stomach as possible. The main reasons for this are that the hyperesthesia of the stomach must be controlled as much as possible, and foods sufficient to maintain equilibrium and if necessary cause an addition in nutrition be employed. The factor of combining the free acidity is really of secondary importance; it is only of value in the way of causing relief for the time being, and is an unwise plan of treatment to put in practice for all cases.

The reason for the latter is, that the stomach in cases of hyperacidity is most sensitive in response to all varieties of stimulation, and the persistent ingestion of high proteid foods is liable to perpetuate the condition (adaptation juice of Pawlow) unless the condition is secondary to some devitalized state of the body or functional disturbance in the general neural system. Still, on the other hand, these foods in the fluid form and simple in character are best to use for a time on beginning treatment, because by this means the element of hyperesthesia is minimized, the subjective symptoms are controlled, they are easily taken, and give high caloric values in small bulks. But at the point at which the subjective symptoms are controlled the proteid elements should gradually be withdrawn, the ultimate object being to make the diet mainly carbohydrate in nature. This latter type of diet must be continued for a long time and test-meal analyses are demanded to see that the acidity does not decrease too greatly or arrive at the lowest possible point. Should it be found that the acidity becomes too low, such foods as the animal proteids can be gradually added until normal secretion recurs. But if it is noted that the acidity is normal or still rather high, the vegetable and fish diet must be continued indefinitely. The dietetic treatment in cases of persistent hyperacidity should continue for from three months to a year, the length of time in the average case being three months. In alimentary hypersecretion the treatment should be continued longer and the number of cases that eventually are given the meat proteids much fewer. The plan of diet that I ordinarily persist with up to a month in the beginning of treatment is as follows:—

This diet is a temporary one and is to be continued until a change is made. The plan of the diet is not to partake of any solid foods whatsoever, and to take the foods that are mentioned at regular intervals of three or four hours during the day, attention being given that a strict regularity is preserved and that the foods are divided up in character and amounts rather evenly for each meal. A glass of plain fresh milk and perhaps a few crackers should be taken before retiring, and if there is distress in the stomach an extra glass of milk during the night. The

diet consists essentially of only four foods, namely, eggs, fresh milk and cream, well-cooked cereals and bread or crackers, and nothing else in the food or fluid line (excepting plain water) should be taken. The eggs may be eaten raw or cooked in any form, or may be taken in the milk. The milk may be warmed if desired, but should not be taken too hot or too cold. The "ten minute" modern breakfast foods should not be employed, and the old-fashioned forms of well-cooked oatmeal, ground corn, farina, rice, tapioca or sago are best. To these a little sugar, but as little salt as possible, may be added. The bread should not be too fresh (one day old), any of the sweetened or unsweetened crackers may be used, and also all forms of simple cake providing there are no nuts, raisins, currants, seeds, or preserved fruits in them. The total amount of food in one day should be: 4 eggs; 1 quart (4 tumblersfuls) of milk;  $\frac{1}{4}$  pound of fresh unsalted butter, or  $\frac{1}{8}$  pound of butter and an extra quart of milk;  $\frac{1}{4}$  pound of cereals; 2 rolls; 4 medium thick slices of white bread;  $\frac{1}{4}$  pound of bakers' cake or crackers, and  $\frac{1}{2}$  pint of fresh cream.

In food values the above diet comprises the following, and can easily be raised or lowered to meet the clinical indications or those of weight and work:—

FOODS.	APPROXIMATE CALORIES.
4 eggs .....	290
1 quart of milk.....	650
$\frac{1}{4}$ pound of butter.....	1116
$\frac{1}{4}$ pound of cereals.....	425
2 rolls .....	175
4 medium thick slices of bread.....	175
$\frac{1}{4}$ pound of bakers' cake or crackers.....	450
$\frac{1}{2}$ pint of cream.....	450
 Total calories .....	 3731

The diet outlined also meets the indication for atony in some of the cases, and answers to control the subjective distress in those of hypersecretion. It will be observed that the symptom of constipation commonly present in these cases is not given attention to in the dietetics. Some authors recommend that in constipation the coarse foods be given, Cohnheim<sup>5</sup> suggesting that in hyperchlorhydria following habitual constipation coarse foods should be used. In my opinion, in no instance of hyperacidity or hypersecretion should the early diet be solid or have any coarse foods. It is best to keep the diet bland in all cases and employ other means (like Carlsbad salts or enema) for the purpose. A stomach that is likely to become highly acid from any secondary cause is always sensitive to the cellulose-bearing coarse vegetable or solid proteid foods, the only difference being that, with the first, mechanical irritation is the cause, and, with the second, it is chemical or physiological in nature.

After a month or more the diet can be changed, four meals a day being allowed, but milk, cream, eggs, crackers, bread, cereals and

butter should always be given the preference. Later on the carbohydrate and hydrocarbon elements should be increased and the more concentrated proteids (eggs) and the total quantity of milk lowered. The foods which then answer to the best purpose are mashed potatoes, spinach, peas, beans, lentils, carrots, strained or eaten in purées; more sugar, cake and dextrinized foods, olive-oil; possibly brains, tripe, chicken, vermicelli, toasted corn bread, pulled bread, zwieback, baked or stewed apples (no rind); stewed peaches, pears, apricots, or prunes (no rind); buttermilk, malted milk, milk with lime-water or Vichy, milk flavored with tea or coffee, kefir, koumiss, junket, whey, cocoa, albuminous water, and the beverages, Vichy, Congress Hathorne, or Carlsbad. In very successful cases when the acidity has been controlled or if anemia or subnutrition from the dieting develops, the very cautious use of the following may be made: Beef, boiled or broiled; raw scraped beef, roast mutton or broiled chops, roast lamb; boiled, broiled, or roasted chicken, turkey, or game, and the accessory meat foods, such as tripe, heart, spleen, sweetbreads, etc. Should these be given, it is better not to discharge the case from observation for the time being, because my experience has been that the freedom in food selection permitted often encourages dietetic indiscretions and a return of the condition. In the majority of cases it is best to eliminate the meat foods entirely for long periods of time; this is certainly true in the long-standing cases of hyperacidity, hyperesthesia, and the higher forms of increased secretion (*gastrosuccorrhea*). Table salt should be interdicted.

**General Treatment.**—General hygienic, physical, and hydrotherapeutic measures should never be neglected in the treatment. Those who are fatigued from overwork should be ordered to rest, and those who have been under a mental strain should be ordered away to the country, seashore or mountains (all being equally good). Outdoor life and physical exercise are most wonderful additions to the treatment. Those who cannot go away should be made to walk seven miles a day. Walking to the place of business and home again with an additional walk in the evenings often makes this practicable without much inconvenience. In the case of women, less carriage and street-car riding, fewer social functions and theaters, and more exercise and open-air life are important factors in the treatment.

In simple hyperacidity gastric lavage is malpractice. It stimulates the stomach to higher acid secretion (even when alkaline solutions are used) and thus does harm. In *gastrosuccorrhea*, on the other hand, considerable subjective benefit can come from the use of gastric lavage, but the analyses of many cases have proven to me that this is not due

to a lessened acidity, but to a raising of the mucous content, which is generally low in these cases.

I have yet to see the case of gastrosuccorrhea, in which stomach washing was practised, benefit in a lowering of the acid content. In these, lavage four or more hours after a meal, late evenings, or the first thing in the morning, with a 1:10,000 silver-nitrate solution, is often helpful, but not curative.

In patients susceptible to the use of electricity the employment of any form would be helpful for a short time. In a proportion of others, intragastric galvanism with the positive pole internally, and if results are not obtained the negative pole internally, is helpful. In persistent hyperacidity and alimentary and chronic periodic gastrosuccorrhea, the internal negative pole with rather a strong galvanic current occasionally gives signal results. When atony or marked constipation exists, the faradic current with slow interruptions or the sinusoidal current is the best to employ. In neurasthenia, high frequency to the spine often serves to good purpose. Of late, because of the success met with in the treatment of ulcer cases, I have employed the therapeutic use of the X-rays in cases of persistent hyperacidity and hypersecretion and have had some striking results from it (due, I believe, to an atrophying effect of the rays on the cells in the gastric tubules, which are proliferated in many of these cases).

The morning cold spray or plunge bath, or the morning rub with a cold, wet towel are serviceable adjuvants. Warm poultices or Priesnitz bandages are frequently useful for the relief of pain, and a spinal hot douche before retiring may be a most grateful procedure in cases of insomnia.

**Medicinal Treatment.**—Alkalies for a long time have properly played an important rôle in the symptomatic treatment of these affections. In all of the forms mentioned positive and almost immediate benefit comes from their use, and no harm develops from their continued employment over long periods of time. As a rule, they should be administered after the taking of foods, the period gauged according to the time that subjective symptoms develop, which is generally at the height of digestion (from one to three hours after meals). In those cases not relieved by taking the alkalies after the meals it is wise before discontinuing their use to try them about fifteen minutes before meals. The forms of prescriptions that are to be recommended are the following:—

## For hyperchlorhydria.

B Magnesii oxidi,  
 Bismuthi subcarbonatis,  
 Sodii bicarbonatis,  
 Sodii exsiccati, carbonatis,  
 Sacchari lactis .....  $\text{aa}$  10.0 3iiss

M. et fiat pulv. Sig.: Take one-half teaspoonful in water one, two, or three hours after meals.

## Or,

B Magnesii oxidi ..... 10.0 3iiss  
 Bismuthi subnitratis ..... 20.0 3v  
 Syrupi acaciæ ..... q. s.  
 Aquæ destillatæ ..... q. s. ad 200.0 f5vij

M. et sig.: Take one tablespoonful (as required in time) after meals, plain or in water.

## When constipation exists:—

B Magnesii oxidi ..... 5.0 90 grs.  
 Mistura rhei et sodæ ..... 200.0 5vij

M. et sig.: Take a tablespoonful (as required in time) after meals in water.

## Or when a powder or mixture is not desired:—

B Magnesii oxidi,  
 Bismuthi subcarbonatis,  
 Pulv. rhei .....  $\text{aa}$  25.0 3vj

M. et fiat tab. no. L.  
 Sig.: Take one or two tablets (as required in time) after meals.

The next drug of importance, and one which is particularly of value in hypersecretion, is belladonna or atropine. This drug effectually inhibits excess secretion, but unfortunately an abnormal state may be acquired, or its unpleasant physiological effects may be such that its employment would have to be discontinued. The hypodermic administration of atropine has been suggested by Riegel, but its use by mouth is sufficient for all practical purposes. It is impossible to prove by test-meal extraction that belladonna or atropine has a useful effect on acidity or secretion, although it does seem to control the secretion in the empty stomach when given hypodermically or in maximum doses. Where there is spasm (pylorospasm, gastrospasm) it is efficient in large doses. The tablets or pills of extract of belladonna, 0.016 ( $\frac{1}{4}$  grain), or atropine sulphate, 0.00065 ( $\frac{1}{100}$  grain), may be given after meals, or these may be added to any of the foregoing alkaline combinations, or given in the following:—

B Extracti belladonnæ ..... 0.32 gr. v  
 Bismuthi subcarbonatis ..... 15.0 3iv

M. et fiat tab. vel chart. no. xx.

Sig.: Take one before meals. (And possibly followed by one of the antacid mixtures mentioned above.)

The bismuth salts, calcined magnesia, and cerium oxalate have a mechanically sedative effect on the mucosa. Bismuth subcarbonate, being a better antacid than the subnitrate, is the most serviceable, and combinations have been mentioned. The following one of Stockton's is helpful:—

B Cerii oxalatis .....	1 part or 10.0
Bismuthi subcarbonatis .....	2 parts or 20.0
Magnesii carbonatis .....	4 parts or 40.0

M. et fiat pulv. et sig.: Take one-half teaspoonful every four hours.

Nux vomica in ascending doses has been strongly recommended by Musser in hyperchlorhydria due to a sensory neurosis. This author claimed uniformly good results from its use. Other bitter tonics are to be avoided.

Nerve sedatives, like the bromides, valerianates, and sumbul, are the most valuable of all drugs to control the symptoms of hyperesthesia. It must be remembered that gastric hyperesthesia is commonly present in these cases, and the symptoms of this are most pronounced when irritation from free hydrochloric acid takes place. A prescription to be recommended is the following:—

B Sodii bromidi,	
Tincturæ valerianæ,	
Fluidextracti sumbul .....	ää 15.0 3iv
Syrupi simplicis .....	q. s. ad 90.0 f3ij

M. et sig.: Take a teaspoonful after meals in water.

Olive-oil and other forms of hydrocarbons have been highly recommended. Cohnheim has written much and always strongly advises the use of olive-oil. The plan of this author is to administer 100 or 200 cubic centimeters of olive-oil (through a stomach-tube) each morning, or it may be given in smaller quantities before meals. The oil coats the interior of the stomach and inhibits the secretion of acid. As a general routine of practice in hyperacidity this treatment is not satisfactory. Many patients object to the use of the tube and others again are nauseated by taking the olive-oil or such quantities of it before meals. Still, when it is easily taken it may be used, because it is efficient in a desirable way, is a good reconstructive to undernourished patients, and may keep the bowels regular. However, no addition of salt to the olive-oil to make it more palatable should be allowed, and it should not be used in cases of fat intolerance or those who complain of headache and eye symptoms after its use. While not so much benefit in controlling acidity comes from the plan of taking fats with the meals, still the heavy indulgence of the more palatable forms (butter, cream, or milk) often serves to good purpose in these cases.

A morning dose of Carlsbad salts in a glass of warm water is an excellent practice in cases of very high acidity or hypersecretion. This salt possesses the double value of neutralizing the acidity present and moving the bowels, and when given well diluted in water it acts as an internal lavage of the stomach. The Carlsbad salts can also be used in doses of about 1 gram (15 grains) in Vichy water after the meals.

As a result of Petri's investigations on the influence of peroxide of hydrogen upon the secretion of HCl in the stomach, a number of authors have reported good results from its use. In 109 cases in which it was employed continuously for two weeks in from 4 to 8 c.c. quantities in a glass of water taken before meals, I have failed to see the "great or total relief of symptoms and gains in weight" as have been reported. Some did benefit, but the proportion was by no means as great or the results any more permanent than those treated with the alkalies and oils.

**Surgical Treatment.**—In all cases of hyperacidity or hypersecretion of a doubtful nature, the treatment should first be medical and kept up for a definite length of time, depending upon the severity and persistency of the case. If after up to six months' time of constant observation test-meal analyses still show a marked hyperacidity or hypersecretion, one of two decisions should be made, namely, the long persistency of medical treatment to afford subjective relief, or surgery. Notable among the cases in which surgery is indicated are: those in which a history of gastric ulcer is obtainable or strongly suggested; those in which a high fermentation of the dextrose content of test-meals suggests these conditions; gall, kidney or pancreatic stones; chronic appendicitis, and those of *gastrosuccorrhea continua chronica* of a primary nature which do not respond to the use of the X-rays. When it is possible to arrive at a definite diagnosis of any of these conditions early, surgery may at once be indicated. The form of operation depends upon the organ involved, always remembering that the performing of a gastro-enterostomy or pylorectomy is only permissible in the primary stomach affections. It would be foolhardy to perform a new stoma operation upon the stomach and leave any of the calcareous conditions in the other organs or a pathological appendix untouched. On the other hand, when other organs than the stomach are operated upon, even should the acidity of the stomach remain high for a time afterward, operation upon the stomach should only be done as a final result. The reason for this is because in cases of secondary hyperacidity and hypersecretion it often takes months before the stomach secretion becomes normal; this is also true in cases of a primary stomach nature when a gastro-enterostomy had been performed, and particularly is this true if a perigastritis or a long-standing atony exists.

**SUBACIDITY, ANACIDITY, AND ACHYLIA.****Classification of States of Diminished or Absent Acidity.**

In no other condition in medicine is there found such a confusion of designating terms as is met with in connection with these conditions. Efforts at classification and simplification have added new ones to their numbers to such an extent that it now seems desirable to simplify these into the terms **subacidity** and **an acidity**, adding to these an etiological connection in those cases in which this is possible. As the subject now stands, some of the terms that are synonymous with subacidity are: hypochlorhydria, hypopepsia, depressed secretory neurosis, subchylia, and hypochylia; and those that are used in connection with an acidity are: achylia gastrica, aepsia gastrica, aepsia, and anachlorhydria. It will be seen that none of these comprises a comprehensive clinical picture, but, instead, a series of peculiarities common to many gastric and general conditions. What was said in connection with increased gastric secretions also holds true here, excepting, of course, that in the latter states the change is downward in percentage. Still more so than with excessive secretion, these conditions are of pathological origin, both in so far as the stomach is concerned and also with organic and functional conditions of the body. Subacidity pertains to the condition in which a subnormal secretion of hydrochloric acid takes place, with or without a lowering of the enzyme content; an acidity pertains to those in which the hydrochloric acid is absent but the enzymes are present; and achylia has to do with those in which neither is present. As these are more or less progressive states, they will be considered together.

**ETIOLOGY AND PATHOLOGY.**

It has been shown that under emotions of excitement or depression the secretory as well as the motor functions of the alimentary canal can be markedly affected. In instances of prolonged anxiety, worry, or suspense, the acid secretory functions of the stomach are usually inhibited, may even be entirely absent for the time being, and but very rarely are increased. In the practical handling of these cases the effects of emotions must be taken into consideration, and too much significance must not be attached to test-meals removed under these conditions; the same is true of those removed on the first day of menstruation. There is, however, a form of subacidity of a neurotic nature in which the hydrochloric acid and possibly also the other constituents of the gastric secretion are lessened in a continuous way. While some of these may be psychic, or of mental

origin, most of those that I have seen are due to debilitated states of the general system from long-standing unhygienic conditions, anemia of a mild or moderate type, neurasthenia, hysteria, Graves's disease, tabes dorsalis, etc. Sub acidity is a most constant finding in the forms of chronic gastritis in which the mucous membrane is degenerated or partly atrophic, in the early stages of cancer and the febrile conditions. In the purely neurotic cases no pathological lesions are present, not even when an acidity exists. In persons who have passed the fiftieth year of life, a marked tendency to diminution of the stomach secretions takes place. In the aged, as Liefschütz has shown, a complete absence of free hydrochloric acid is not a rare phenomenon. Added to these are also the causes of an acidity and achylia, which are described in the following paragraph:—

The cases of achylia may be divided into those who have had the condition all their lives and having had no digestive symptoms are not aware of it; the cases of simple depression of the secretory function due to reflex irritation, neurasthenia, or low states of general nutrition in persons in whom the condition disappears as improvement in general health takes place; pernicious anemia, or long-standing diarrhea in which no pathological lesion of the stomach can be found; and, finally, the second form seen in atrophic gastritis, gastro-enteric atrophy and malignant disease. In by far the largest proportion of cases of achylia a form of chronic gastritis is present in which there is seen a soft and vulnerable mucous membrane easily bruised, with a granular degeneration of the cells and round-cell infiltration (granular gastritis). The next most numerous cases are those in which the characteristic pictures of a well-advanced atrophic gastritis is noted. While it seems to be conclusive that cases of achylia can exist without anatomical lesion in the stomach (achylia nervosa), still the fact that no excessive amount of mucus is noted in the test-meals or in the absence of a history of cause, one should not be too hasty in assuming that we are not dealing with a condition of distinct disease in the largest proportion of cases that are seen. Fruitful among the causes that may produce the granular or atrophic forms of gastritis having achylia are: alcoholism; the prolonged administration of certain drugs, such as salicylates, mercury, etc.; the intemperate use of tobacco, particularly when it is chewed; continuous circulation of toxins in cases of chronic nephritis and putrefactive conditions in the gut, long-standing anemias, states of subnutrition, arteriosclerosis, nephritis, heart disease, diabetes, pulmonary tuberculosis, tapeworm, and cholelithiasis. Less advanced states of all of the above may give rise to sub acidity. True achylia in which there is a total lack of acid and enzymes through the

entire period of digestion is exceedingly rare. Every one of those cases, in my opinion, are those of late atrophic gastritis.

We must realize that the term achylia gastrica is very loosely used, for, although of a large series of cases studied that showed no hydrochloric acid, in the majority the pepsin was absent, in some it was present even in normal amount. Roughly speaking, we use the term to mean no hydrochloric acid in the gastric contents after the ordinary test-meal with a total acidity under 12 or 15, and with a hydrochloric acid deficit, although Rehfuss by his fractional methods of study insists that in some of these cases free hydrochloric acid may appear in the gastric contents long after the usual time of extraction of the meal. It was not many years ago that the absence of hydrochloric acid was considered, if not diagnostic, at least extremely suggestive of gastric carcinoma. To realize the error in this point of view and to show that in the vast majority of cases achylia is associated with benign conditions, one has but to mention its presence in a large series of cases. We must realize, of course, that it may represent the late stage of an inflammatory process, or an atrophy of the mucous membrane, or a lack of functional activity of the glands, either due to a pure neurosis, to psychic disturbances, to a toxemia, or to a reflex inhibition from elsewhere, as, for example, the achylia frequently met with during menstruation.

The conditions in which we met with an absence of hydrochloric acid with peculiar frequency or of especial interest are:

1. The last stages of a chronic gastritis.
2. Gout and arthritis deformans, or perhaps better called chronic infectious arthritis, leading in the first case to the substitution of an acid for an alkaline therapy, and in the latter to the belief held by many in the intestinal origin of the disease.
3. Various infectious diseases—tuberculosis where it is often found and typhoid fever, in the latter of which in a number of cases we have found a complete achylia following the disease, which may be one of the causes of the gastro-intestinal symptoms often met with, which is probably toxic in origin and not due to destructive changes in the glands, as in many cases after a considerable period of time, in several of our cases more than a year, there was a gradual return to normal gastric juice, and in all these cases the use of hydrochloric acid therapeutically should be advised; sinusitis, pyorrhea alveolaris—a very frequent cause, probably leading to a true infectious gastritis and being the most potent factor in the gastric dyspepsia and diarrhea in older people—and tonsillitis.
4. Various intestinal parasitic diseases, especially infection with the uncinaria—hook-worm disease—though frequently found in infections with tapeworm, round worm and entameba.

5. Conditions associated with chronic passive congestion, notably chronic nephritis and myocardial disease.

6. Pernicious anemia, a group of peculiar interest because of the resemblance of the symptoms to gastric cancer.

#### SYMPTOMS.

The symptoms of subacidity, an acidity or nervous achylia vary greatly, and often there are no subjective symptoms at all. Sensations of epigastric pressure, fullness, eructation, anorexia, diarrhea, intestinal disturbance, occasional nausea, headaches, great nervousness are the most common. These patients often show more or less general disturbance in health, and in cases of gastritic achylia a condition of more or less debility, mild invalidism, or susceptibility to disease is common.

Einhorn<sup>6</sup> makes a clinical division of achylia gastrica into three groups: "(1) In individuals having no gastro-intestinal symptoms whatever, and who are in good general health. (2) Patients presenting a greater or lesser number of gastric symptoms. (3) Patients having apparently no gastric symptoms, but presenting marked intestinal disturbance." (To these may be added the cases in which both gastric and intestinal symptoms are present, and those which have no gastro-intestinal disturbance but present the general symptoms of anemia, devitality, quick exhaustion, and lack of resistance to disease, making five in all.)

The main symptom for diagnosis is the objective one of test-meal analysis. In subacidity an absence of free hydrochloric acid is often noted or the dimethylamidoazobenzol solution or paper will show only a faint reddish tinge. The analysis usually proves that such of the natural acid as was secreted is in combination with the food elements, the total hydrochloric acid being from 1 to 30 degrees and the total acidity about 10 more. In an acidity no hydrochloric acid results in the tests are noted, but a few degrees of total acidity, with more or less of the pro-enzyme, are present. The latter should always be tested for, so as to separate the cases of an acidity from true achylia; this is important from both a diagnostic and prognostic standpoint. In achylia no free or combined hydrochloric or enzyme is present, but a few degrees of total acidity may be noted. Other test-meals, however, are absolutely neutral or even alkaline in reaction. In cases of achylia in which general symptoms of reduction of health are present, a high albumin loss of food in the feces is usually noted. No case should be diagnosed as an achylia on negative results of acidity on the Töpfer

method alone or without a fractional test-meal being made up to 2½ hours. The Hayem-Winter method of estimation of the total chlorides and the tests for the enzymatic power of the gastric filtrate should always follow, and, furthermore, the absence of HCl and enzyme must be noted on every occasion of examination of test-meals (and several should be extracted), and the morning stomach should be examined for desquamating tubule cells (atrophic gastritis) before the diagnosis is accurate. By the observance of these rules, the number of cases of "achylia gastrica" will fail to such an extent that the above term will be nowhere near as frequently used as it is to-day. During the menses, a diarrhea, constipation, motor disturbance of the intestines, and high, low or absent secretion in the stomach may occur.

#### PROGNOSIS.

The prognosis in cases of subacidity and an acidity depends upon the possibility of removing the cause; usually, however, it is good. These and the cases of achylia in which no gastro-intestinal or general symptoms are present, generally continue in good health, although those of achylia due to gastritis require watching that the general health is maintained. The prognosis in achylia cases in which symptoms are present depends upon whether the condition is a primary or secondary one, and upon its nature. Excepting in cases of malignant disease, pernicious anemia, chronic nephritis, etc., the prognosis for continued life is good. When well in hand, unless the disease is far advanced and complications are present, cases of atrophic gastritis or gastro-enteric atrophy do well on treatment, but cannot be cured. The same may be said of those due to granular gastritis and the long-standing diarrheas.

#### TREATMENT.

**Dietetic.**—The diet in these conditions forms the most important item of treatment. The main factors to be kept in mind are: to supply just enough proteins as can be digested by the hydrochloric acid secreted in subacidity; to give proteins of such kinds, form, and quantity as can be readily digested in the intestine in the cases of an acidity and achylia; and to maintain the highest degree of nutrition in all of the cases so that general strength can be maintained or if possible improved. Important to these ends is the use of foods that are in a finely divided state and the liberal employment of the well-cooked carbohydrates. When there is some acid secretion present, the meats may be given; but these should always be in limited quantities and finely divided. In a few of the cases of an acidity and achylia a small amount of meat or the sub-

stitute meat foods (brains, boiled sweetbreads) are well taken care of in the bowel, and in these instances they should be advised. As a rule, however, it is impossible to foretell in which of the cases this will be found, but they comprise mostly the neurotic and congenital cases. High albumin loss with the recovery of a large amount of the red meat fibers in a striated or unseparated condition in the feces is found mostly in achylia due to pernicious anemia, gastroenteric atrophy, nephritis, and diarrhea. Still, even in these cases, if no special digestive distress from meat is met with, they may be given; but, of course, in very small quantities, frequently repeated, and always finely comminuted. Milk as a rule is not well tolerated, its digestion causing stomach distress and perhaps a diarrhea. Of the liquids, broths, such as rice, chicken, barley, albuminous drinks, and raw or soft-boiled eggs, are recommended. The protein-bearing carbohydrates (peas, beans, lentils) in purée form or broth are useful. Potatoes, rice, tapioca, sago, and farina well cooked in water or milk are very well borne. Any of the breads, rolls, simple cake, or crackers with butter in moderate amounts are well tolerated. Tea, coffee, cocoa, and, in milk intolerance, koumiss, kefir, or matzoon may be allowed. In cases of acidity and achylia the following diet list is of service. As these patients are most difficult to supply with a variety of foods so as to prevent monotony, a list is here given:—

The plan of diet is to partake only of fluid or semifluid foods, taking these at three or four hour intervals during the day and evening and preserving a strict regularity in time. The vegetables (excepting the rough ones), starches, and cereals, all of them cooked to as soft a consistence as possible and taken in a mashed porridge or fluid form, are wholesome. The quantity taken at a time should be moderate and best spread over ten minutes of time at each feeding. The meals should be begun at 8 A.M. and ended at 10 P.M. Among some of the preparations of food that would serve of value in such cases are the following:—

#### ALBUMINOUS DRINKS.

Egg broth.	Matzoon.
Eggnog.	Junket.
Junket eggnog.	Rice milk.
Beef eggnog.	Mutton broth.
Albuminized water.	Nutritious beef broth.
Albuminized clam-water.	Broth with grains.
Grape yolk.	Egg broth.
Grape juice and egg.	Cocoa.
Malted milk and egg.	Malted milk cocoa.
Koumiss.	

#### SOUPS (with or without noodles, crackers, or croutons).

Cream of celery soup.	Mock bisque soup.
Celery soup (gum gluten).	Green pea soup.
Corn soup.	Rice soup.
Asparagus soup.	Victoria soup (with broth).
Tomato soup (with broth).	

**CEREALS.**

Flour gruel.	Rice farina and oatmeal gruel.
Porridge.	Gum gluten breakfast food.
Cracker gruel.	Cornmeal mush.
Barley gruel.	Hominy mush.
Barley gruel with broth.	Rolled oats.
Arrowroot gruel.	Steamed rice.
Indian meal gruel.	Boiled rice, farina, tapioca and sago

**FRUITS.**

Pineapple.	Baked apples and apple sauce.
Baked banana.	
Steamed rhubarb.	Stewed prunes.

**PASTRY.**

Rolls, any kind.	Cake or crackers, any simple kind.
Bread, any kind.	

**SHELLFISH.**

Raw oysters (no condiment excepting lemon).	Oyster stew and oyster soup.
Pan roast oysters.	Creamed oysters.
Broiled oysters.	Scalloped oysters.

**Eggs (4 a day).**

Soft boiled.	Plain omelet.
Steamed or baked eggs.	Foamy omelet.
Golden rod eggs.	Bread omelet.
Egg nests.	Poached eggs plain.

**FISH.**

Creamed fish.	Baked or boiled fish (plain sauce).
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**VEGETABLES.**

Boiled potatoes.	Peas,
Riced potatoes.	Beans, } in purée form.
Mashed potatoes.	Lentils,
Creamed potatoes.	Spinach.
Baked potatoes.	

**DESSERTS.**

Soft custard.	Cornstarch, fruit jelly.
Meringue or floating island.	Gum-gluten pudding.
Banana, peach or apple custard.	Rice pudding, peaches and rice.
Baked custard.	Steamed and boiled rice.
Chocolate.	Rice meringue.
Malted milk or baked caramel custard.	Cream of rice pudding.
Fruit whips.	Chocolate or cocoa blanc mange.
Soufflés.	Plain or tapioca cream.
Junkets (custard, cocoa, coffee, plain).	Pineapple, apple or raspberry tapioca.
Cornstarch pudding.	Bread and cracker puddings.
Pineapple cream.	Gelatin.
	Jellies (fruit and cereal).

Because many cases of sub acidity, an acidity and achylia are continuous conditions, the diet must be maintained over long periods of time and thus it is impracticable to maintain the caloric principle of feeding in a scientific way constantly. Therefore, it is wisest to give a long list of available foods and preparations like the preceding, and observe the maintenance of nutrition by the constant use of the scales and the appearance and state of health of the individual. In selected cases the meats may be added in small quantities.

**General Treatment.**—Other than the diet and unless some organic condition of the stomach exists, most of these cases do not require treatment for the stomach alone, but rather for the general condition that is causing it, and for this reason the very highest standard of body nutrition through the diet is important. Intragastric faradism may be used when the gastric motility is impaired. In the cases in which a general neurosis is the cause of the low or absent gastric secretion, the physical and hydrotherapeutic treatment may, under favorable circumstances, act indirectly in producing a secretion of hydrochloric acid. But in the cases of long-standing achylia care must be exercised in advising forms of physical exercises, for the reason, first, that these patients are not physically strong and are hard to build up, and, secondly, that they peculiarly constitute a class of patients who are easily and quickly bored unless the form of exercise is entertaining as well (golf, tennis, walking, outdoor work, etc.). My observation has been that regular physical exercise followed by baths and massage form an excellent adjuvant to the treatment of lowered and absent gastric juice conditions.

**Medical Treatment.**—Drug treatment represents, on the one hand, a substitution therapy, and, on the other, an attempt to increase the secretion. Pawlow has shown that raw meat, meat juice, meat broths, Liebig's meat extract, gelatin, and certain peptones stimulate the secretion of gastric juice. Small amounts of alcohol have been shown to do likewise, and the occasional use of Byrrh wine or Dubonnet before meals may be used for the purpose. In a few of the cases the gustatory stimulation from the use of the bitter tonics may activate a hydrochloric secretion, but this is by no means common enough to deserve first attention in the treatment. In this, what cannot be accomplished by the use of hydrochloric acid, either in lavage or given diluted by mouth, cannot be accomplished by any drug known to-day. As to which of the cases is going to respond best to the acid administration, and which best to the alkaline, it is usually impossible to foretell in the beginning. In this there is hardly less difference between the subacidities and anacidities and the achylas. Nevertheless, I have noticed a few practical points, and they are that the acid treatment is effective in most of the diarrheal and

neurotic cases and a few of pernicious anemia. Most of the cases of late atrophic gastritis and nephritis, and a few of the neurotic conditions do badly on the acid, and its use must be discontinued because of the stomach distress that is caused. Still, one can never be sure of the outcome in advance with any one of the types, and, since the use of the acid treatment is the most rational one, it is always best to give it a few days' trial, perhaps telling the patient at the time that a little harmless experimentation would be necessary in the beginning of treatment. If it stops the gastric distress, the treatment for that case should be an acid one, and if it intensifies it, the very opposite, namely, an alkaline. One or two tablets of hydrochloride of betain (acidol) may be used in place of the dilute hydrochloric acid, these being handier for the patient to carry than the acid.

When well borne, from 2 to 6 cubic centimeters (30 to 90 drops) of the dilute hydrochloric acid should be put in a glassful of water, one-fourth of the amount being taken at quarter-hour intervals after a meal. It is best to accompany the acid with a pepsin preparation. In the diarrhea of achylia bold administration of acid is often most helpful.

Acid. hydrochlor. dilute.,			
Pepsini puri .....	5.0	10.0	
Aquaæ .....	50.0	100.0	

Sig.: One teaspoonful in a glass of water, to be taken before and during the meal.

When the acid is badly tolerated, the stomach digestion should be rendered alkaline, the stomach as an organ of digestion being practically considered as a part of the intestine, its only function being that of a receptacle for food. In such instances the following harmless prescription serves to good purpose:—

B Pancreatini .....	10.0	3iss
Sodii bicarbonatis .....	20.0	3v
M. et fiat pulv. no. xx.		
Sig.: Take one powder in water after each meal.		

For anorexia there is no better treatment than insisting upon taking sufficient quantities of food, and the use of tincture of nux vomica, 1 cubic centimeter (15 drops) well diluted before meals. In anemia a high feeding should be kept up, and in the cases that will not tolerate acid the non-astringent forms of iron given, and in the acid-tolerant cases the stronger forms of iron, of which the tincture of ferric chloride is the most effective, particularly when kidney complication exists. A good prescription is the following:—

B) Tincturæ nucis yomicæ .....	8.0	fʒij
Tincturæ ferri chloridi .....	10.0	fʒiiss
Syrupi simplicis .....	q. s. ad	90.0 fʒiij

M. et sig.: Take one teaspoonful well diluted in water one-half hour after meals.

Rhubarb or cascara may be used in constipation, and colonic flushings, either per rectum or after appendicostomy, would be preferable in the cases of gastro-enteric atrophy with marked secondary anemia or pernicious anemia. When no atony exists, the use of the sodium-chloride waters, Kissingen, Wiesbaden, and Homburg, are sometimes of help, taken with the meals.

#### HETEROCHYLIA.

This term was devised by Hemmeter<sup>7</sup> to denote an alternating state of secretion occurring chiefly in "nervous dyspepsia." A number of authentic cases have been reported from several sources, in which at different times within a short period the stomach analyses show a sub-acidity and hyperacidity; more commonly, however, are those which run from an acidity to hyperacidity. It is most probable that the condition is not of stomach origin, but due to a neural source in which the innervation of the vagus or sympathetic is mainly affected. Among the symptoms that have been reported are anorexia, and a sense of weight and fullness in the stomach when the acid is low, and pyrosis and eructations when it is high. The state of secretion seemed to depend much upon the neural condition present at the time.

The treatment in these cases was mainly hygienic, climatic and high proteid findings, both of them making substantial improvement and obtaining a more steady gastric secretion in the course of time. In this it is well to remember that the treatment should be general in so far as the body nutrition and neural condition are concerned, the resulting stomach condition being only of secondary importance.

#### GASTROMYXORRHEA.

Dauber<sup>8</sup> was the first to point out that under abnormal conditions a flow of mucus can occur from the stomach. Among these cases are excepted those in which a small amount of mucus is obtained from the fasting stomach. In fixing the standard of departure from the normal, Kuttner regards the recovery of more than 5 cubic centimeters of mucus from the fasting stomach as pathological, but considers the condition one of gastromyxorrhea when more than 25 cubic centimeters are obtained. The cases of gastromyxorrhea have been divided

into those in which the increased mucous flow occurs at intervals (intermittent gastromyxorrhea), and the much more frequent form (continuous gastromyxorrhea). It is probable that many of these cases are not recognized and that the condition is more common than is supposed. The reasons for this are that extractions from the empty stomach are not sufficiently common routine examinations, and in the chronic form the subjective symptoms of distress are not suggestive, and, in fact, as I have observed on four occasions, may not be present at all.

Up to this time two etiological connections have been made. Kuttner believes that in the acute forms there is some connection between the affection of the nose and that of the stomach, and in the 2 cases he reported the attack took its onset with increased discharge from the nasal membrane. In the chronic form the condition may accompany subacidity or an acidity, the various organic diseases, or may exist as an independent functional neurosis. Kuttner found it most frequently with chronic gastritis, and, in my experience, it is not uncommon to obtain large amounts of mucus from the fasting stomach in the cases of so-called gastritis acida. It has been assumed that the origin of the mucus is mostly from the glands of the pylorus and less so from the epithelium and other mucous glands of the stomach.

The symptoms in the intermittent cases are a short prodrome of headache, nausea, and anorexia, present usually in the mornings for one or two days. This is precipitated into an attack of severe vomiting of an intractable type, the vomited matter consisting of large quantities of tough, slimy mucus, and finally mixed with bile and intestinal juices. As a rule, no pain is present and the symptoms of prostration may be marked. Such an attack may last from a few hours to several days, terminating in a quick return to a normal condition of digestion. A case I had under observation in which moderate gastroptosis and myasthenia also exist has had these attacks for seven years, in the beginning occurring about four times a year, and recently about every ten days and lasting for from one to three days. The surprising feature of this case was the intense distress and character of general symptoms present during the attacks, at which time the patient was unable to leave the bed, and the quick return to normal appetite and absolutely tolerant stomach at its termination. In this man the test-meal analysis shows a normal percentage of hydrochloric acid and enzyme in the interval, and on one occasion at the onset of the paroxysm I aspirated 37 cubic centimeters of almost pure alkaline mucus from his stomach. The chronic

form is usually devoid of subjective symptoms of distress, the diagnosis only being possible by an aspiration of the fasting stomach after that of a test-meal. Quite naturally, if the return of gastric mucus from the morning stomach is acid in reaction, a diagnosis of true *gastromyorrhea* should be made with hesitancy. Care must be taken to distinguish the mucus swallowed that emanates from the respiratory tract.

Regarding the treatment of the acute form, during a paroxysm a thorough lavage of the stomach with an alkaline solution may terminate the symptoms at once; later on it is useless and too distressing. A hypodermic injection of morphia may be called for as well as external applications of heat to relieve the distress. The best constant treatment, in my opinion, is the use of ascending doses of *nux vomica*, working these up very gradually until physiological effects are produced, and then continued for some time afterward at a smaller dose. Should the paroxysms be frequent, belladonna in fair-sized doses during the day or 1 rather large-sized dose at bedtime is very helpful. The acute cases that I have seen (only 3) all had had the condition for years, and at the time were in poor general condition, and thus required tonics, climatic and hygienic attentions to improve them. Regarding the continuous cases there is no more efficient treatment than morning and evening lavagings with an alkaline followed by the hydrazine solutions. *Nux vomica* and belladonna may also be used, but effort should be made to diagnose some primary pathological condition if possible, after which the treatment would be according to the disorder found and the general condition of the patient.

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## CHAPTER XXX.

### Functional Disturbances of the Stomach.

*(Continued.)*

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#### DISTURBANCES OF SENSATION.

##### HYPERESTHESIA GASTRICA.

UNDER this term is described the condition in which the glandularis (mucous membrane) of the stomach is hypersepsitive to even normal stomach contents. The simplest forms of foods or drink will often cause distress in spite of a normal condition of secretion and motility. In a large number of cases, particularly in the Semitic races, the symptoms of distress are more or less continuous and become immediately intensified on ingestion. Altogether, hyperesthesia gastrica comprises by far the largest proportion of gastric conditions, even among the class of neurotics alone. As a condition it accompanies practically all of the primary stomach disorders and many of the secondary conditions as well. For these reasons it may be looked upon as the simplest form of all gastric disturbances, and, excepting in the purely dietetic cases, may be considered more of a symptom than a clinical entity.

Of the true gastric affections in which hyperesthesia is noted may be mentioned all of the states of abnormal secretions, especially the two extremes of hyperchlorhydria and achylia, and neurasthenia gastrica. My experience has been that the instances of this condition are fewer in the purely neurotic states of sub acidity, unless the lowered secretory change is secondary to a state of destructive gastritis. There is no absolute uniformity in this, however, because even in sub acidity a marked hypersensitiveness may exist requiring alkalies for its relief, and also that instances of an acidity are seen in which none of these symptoms are present. Furthermore, it has occurred to me that the slower a chronic gastritis is established the surer it is that these symptoms are a feature, and in the more rapid and deeper destructive forms they are commonly less noticeable or pronounced. Confirmation of this may be noted in gastritis secondary to malignant disease, or atrophic gastritis in which it is not unusual to note that the symptoms of hypersensitiveness are absent or may not come on until late. But it can be clinically observed in a number of these latter.

mentioned cases when this sensitiveness to foods is established that it is liable to be most intense, persistent or progressive, and thus intractable to treatment. Of much interest also are the many body conditions or diseases of other organs in which hyperesthesia of the stomach can be looked upon as secondary or referred conditions. Many of these are mentioned in the stomach conditions in diseases of other organs which have been described.

**Etiology.**—As a simple primary affection hyperesthesia is found in long-standing dietetic indiscretions, in neurasthenia and hysteria, in states of anemia, general debility and mental strain, in instances of excessive sexual indulgence, in hyperchlorhydria and an acidity of an acquired type, and in gastric ulcer and chronic gastritis. Among the improprieties of ingestion in which it is found are the occasional excesses in overloading the stomach with foods or drink, results from debauches not severe enough to cause the development of an acute gastritis; the steady abuse of tea, coffee, alcohol, tobacco, highly seasoned foods and opium or cocaine; in subnourishment resulting from insufficient diet, and also from eating irregularly. Post-ulcer hyperesthesia has been described, also that of chronic gastritis and splanchnoptosis. It is found more frequently in females, the disproportion being greatest in the middle adult years.

**Symptoms and Diagnosis.**—The sensation produced is that of mild pain (severe pains are gastralgie), fullness, and weight or pressure coming on immediately upon the ingestion of foods or drink. In the severe cases in which the gastralgie type of pain is not present, a sensitiveness may exist in the stomach causing nausea or even vomiting; the latter, however, is due more to a desire on the part of the individual to unload the stomach than the truly symptomatic kind. Fluids, particularly the very cold, and sweetened or carbonated drinks may cause more distress than solid foods. As a result of the distress the patient fears to partake of sufficient amounts of food, and thus may lose weight and strength and become anemic. The symptoms of hyperchlorhydria, pyrosis, water-brash, and flatulence, coming on late after meals may be present. In my opinion, the one main clinical point in diagnosing this condition is the time after ingestion that the symptoms of distress occur, which in all cases is immediate and before gastric digestion has begun or advanced to a practical degree of conversion of foods. Test-meals from these cases show a normal secretion with perhaps slight variations, and generally a normal motility of the organ. The diagnosis is made from the dietetic history of the case and the subjective gastric symptoms. In persistent cases all of

the local and general conditions must be excluded before diagnosing primary hyperesthesia. In catarrh and hyperchlorhydria the stomach symptoms usually come on some time after eating. When there is doubt, the facts that the appetite remains good and the secretions and motility normal are helpful to diagnosis. Also, in hyperesthesia, the stomach distress is quite independent of the character and amounts of food.

**Treatment.**—According to many authors, the treatment should be begun by placing the patient in bed, the institution of a milk or egg albumin diet, and the systemic care of the individual until the symptoms are controlled. While I agree with this for the severe cases, and to an extent with Rosenheim for the chlorotic cases, I can only say as a routine of treatment for all cases, that about one-half of all gastric disorder patients who apply for treatment would make up such an army that very soon there would be no room in all of the hospitals to hold them. In practical work, with patients intelligent enough and with purpose enough to follow directions, only a small proportion of cases need go to bed to get well. The most important feature of the treatment is to recognize and treat any of the causative conditions that exist. When these can be eliminated, and the severe types of the condition are separated for the bed treatment, the routine of care in the average cases is about the following:—

According to the history obtained, all dietetic causes, matters of abuse, habits, etc. must be stopped. The diet is essentially that described under hyperchlorhydria found detailed on page 851 and this should be prescribed and persisted in until the sensory symptoms are under control. There is a small proportion of cases in which even with the greatest care in the diet the symptoms do not abate, not even after lengths of time. In such, the stomach and other organ conditions of a pathological or constitutional nature must persistently be searched for, and if found attention to them must be given as a primary essential of treatment. Should the case still seem to be one of distinct hyperesthesia gastrica, the bed treatment should be given first thought, and if this is not possible, or in the beginning of treatment in all, resort to drugs is generally required. The condition which gives the most degree of confusion is an underlying obscure form of neurasthenia, one in which the general symptoms as well as those in the digestive tract are not distinct. There are other cases again which may have a sub acidity of the stomach during gastric digestion and, as paradoxical as it may seem, do best on the alkalies (not the instances of larval hyperacidity). These cannot be separated in advance and can only be noted by experimenting for a short time

with an acid or an alkaline treatment; these are probably due to a sensitiveness situated in the deep layer of the glandularis. The high caloric feedings and the routine administration of iron are always in order in the anemic or undernourished patients. The drugs which answer to the best purpose to control distress are the bromides, and it is not unusual to have to employ these in very large sized doses for a short time and perhaps for one or two months all told. Among the prescriptions for these cases that can be recommended, in addition to the one given in the foregoing chapter, are:—

B. Sodii bromidi ..... 10.0 to 25.0  $\frac{3}{4}$ iss to  $\frac{3}{4}$ vj  
 Aquæ menthæ piperitæ ..... 250.0  $\frac{3}{4}$ vij  
 M. et sig.: Take a tablespoonful in water after meals.

Or,

B. Sodii bromidi,  
 Tincturæ valerianæ .....  $\frac{1}{2}$  10.0  $\frac{3}{4}$ iss  
 Aquæ chloroformi ..... 100.0  $\frac{1}{2}$ ijij  
 M. et sig.: Take a teaspoonful in water after meals.

Or, when constipation exists:—

B. Tincturæ rhei,  
 Tincturæ valerianæ .....  $\frac{1}{2}$  10.0  $\frac{3}{4}$ iss  
 M. et sig. Take twenty drops in water after meals.

Supplemental treatments that answer to good purpose in many of the cases are: the hygienic and hydrotherapeutic measures, cold compresses to the abdomen to relieve the distress, galvanism, occasionally the use of nux vomica in small doses, lavage with silver nitrate, belladonna, and a sojourn in the country away from work and other activities.

#### GASTRALGIA NERVOSA.

Gastralgia is a condition characterized by periodic or spasmodic attacks of more or less severe pain in the stomach, appearing independently of the ingestion of foods, subsiding in a short time, and followed by an interval of complete freedom from symptoms. Gastralgia is about three times as common in women as in men, and altogether comprises about 2 per cent. of the cases of neuroses.

**Etiology.**—The manifestation of gastralgia may be clinically described as a sensory disturbance affecting the vagus, either directly or indirectly, and locally or generally along the course of the nerve. The most frequent cases are those in which the terminal branches in the stomach are affected. Among the most numerous causes that may bring this condition about are: excessive indulgence in tobacco, irregular and insufficient eating, the constant intemperate use of soda-

water, particularly the kinds that are not flavored with the natural fruit juices, but with artificial flavors; the habit of drinking iced fluids; and the taking of a large amount of iced drink at some one time, perhaps when overheated or very thirsty, the result of an alcoholic debauch, particularly when much sweetened forms of spirituous drinks (cordials) has been taken; the drinking of much strong tea, coffee, or lemonade, and, finally, the forms that may be considered as the deeper developed types of hyperesthesia from dietetic reasons.

I have seen gastric cases included under all of the foregoing. To such may be added cases of ulcer or adhesions of the stomach, gallstones, chronic appendicitis, and certain forms of acute gastritis, particularly the congestive, inflammatory, or hemorrhagic types. Gastralgias of central origin may be noted in the crises of locomotor ataxia, the cerebral tumors and myelitis, and those affecting the course of the nerve may be observed in the anemias, infections, intoxications (lead, gout, opium, cocaine, and autointoxications from the intestine), and hysteria and neurasthenia. Of the indirect types may be seen those in which the innervation of the vagus is disturbed by referred stimuli from disease of other organs, and in these are found cases of nephroptosis with Dietl's crises, gastrophtosis, enteroptosis, coloptosis, the inflammatory diseases, and circulatory or anatomical defects in the generative system.

**Symptoms and Diagnosis.**—The attacks of pain, as a rule, appear quite suddenly, although they may be preceded for a few hours or days by premonitory symptoms, such as anorexia, headache or backache, vertigo, fullness or weight in the stomach, slight precordial or stomach pains, and nausea and perhaps vomiting. In the majority of instances the history of these are not obtained unless definite questions are asked, and may even be denied altogether. Within a very few minutes after the onset of the attack the suffering from pain is extreme. This is located in the epigastric and left hypochondriac regions, and is variously described as burning, boring, tearing, cutting or pressing. From the stomach region the pains may radiate into the left thorax, left shoulder, back or general abdomen, and may be so intense as to cause weakness and collapse (rapid, thready and irregular pulse; pallor, cold extremities, cold sweat, subnormal temperature). The expression at the time is usually anxious and drawn, and frequently the patient is unable to lie down or sit straight, an attitude being assumed which gives the greatest degree of relief by the relaxation of the abdominal muscles. Among such is a half-sitting position with the knees high and shoulders bent forward, and when lying in bed, on the side in about the same bent position. The

abdomen is mostly sunken and the gastric region tympanitic (the latter is best noted by comparing the percussion note over the lower ribs, seventh to tenth, on both sides). There may be a tenderness on slight pressure over the stomach, and a sense of relief on steady deep pressure. At times these symptoms are accompanied by nausea, vomiting, nervous chills or hysterical manifestations. The duration varies from a few minutes to several hours, and the interval between the attacks may be days, weeks, months or years. The seizures generally cease quite as quickly as they come on, the short attacks being followed by a desire for food and ability to be about in a few hours. When the attacks have been prolonged (several hours) they are often followed by a feeling of weakness which lasts for several days. In the gastric crises of locomotor ataxia the attacks may be ushered in by a series of lightning pains in the legs, those in malaria occur when the paroxysm of chill and fever is on, and in neurasthenic females the seizures are more liable to occur at the menstrual period (Boas).

The diagnosis is made on the history, the character of the symptoms, the observance of certain constitutional, central, or other organ disease, and the short duration of the seizure. In recurring gastral-gias, when no distinct cause can be assigned, examinations for latent or healed ulcer, perigastric adhesions and other conditions should be made. The pains of cancer are more steady, not so severe, and have no free intervals. Blood in the test-meals or feces is not present in true gastral-gia, and during the interval of attacks in the majority of cases no secretory or motor change from the normal is observed; a few, however, may have a hyperchlorhydria. Among the other stomach conditions with which this may cause confusion are, hypersecretion, gastromyorrhea, cardia or pyloric spasms, neurasthenia gastrica, and achylia. The diagnosis is particularly to be made from biliary colic, and in cases of gastral-gia in which the pains are not so severe and more colicky in character this may be difficult or impossible for the time being.

In the gall-stone cases, other than the definite symptoms, the pains are more to the right of the median line and in the biliary triangle during the interval of attacks, and referred to the right side of the body during the colic. The pains of nephritic colic radiate down the back, the crural region, and toward the bladder. Instances of intestinal colic or enteralgia must also be excluded. In these the pain is never sharply localized in the gastric region, may be anywhere in the abdomen, and is usually migratory. Intercostal neuralgia and herpes zoster of the lower left dorsal nerves must also be excluded, and this

is done by observing a tenderness along the course of the nerves, and in the latter by the appearance of the characteristic eruption. The condition must also be diagnosed from angina abdominis (sclerosis of the vessels of the upper splanchnic area), and tabes.

**Treatment.**—In the treatment of gastralgia it is important to direct attention to the underlying cause. The treatment therefore develops itself into that for the relief of the attacks, the treatment in the interval, and that of such other causative factors as may be present. Since the latter are contained under those of the various separate conditions, only the first will be described.

During the attack a hypodermic injection of morphine with atropine may be necessary to quickly control the pains. Hot compresses may be applied to the abdomen in the less severe cases and one of the bromide mixtures may suffice. Chloral hydrate by mouth or rectum answers well when the seizure is prolonged. Foods and drink should be withheld for the time being. The external use of strong galvanic currents, with the anode in the epigastrium and the cathode on the spinal column, has been advised to control the pain. In severe cases strychnine administered as a tonic for a few days may be necessary to strengthen the patient.

In instances of the so-called idiopathic gastralgia, or rather the neurotic gastric form, treatment in the interval is most important. The use of tobacco and alcohol must be interdicted, regular eating habits should be advised, and the taking of cold drinks, soda-water, tea and coffee and strongly stimulating foods should be stopped. The iron tonics or arsenic would be beneficial in anemia, quinine should be given in small doses for about three weeks if there had been a history of malaria, and an underlying hysteria or neurasthenia should be treated by general tonics, good foods, regular living, lengthening the period of rest in bed each day, fresh air, outdoor exercise, massage, and the hydrotherapeutic measures.

In persistent cases, when gastric ulcer, gastritis, and the extra-gastric conditions can be excluded, the intragastric employment of the galvanic current answers to good purpose. Einhorn advises its use for from four to six weeks. Following his advice, I have noted most striking results from this treatment, but it has been my observation that current from the chemical batteries (from cells) is efficient, while that from a wall plate run by a commercial current is not or only very slightly of value. In the instances of neurasthenia, the cure is slow, and always one of reconstruction and strengthening of the weakened neurons.

**NEURASTHENIA GASTRICA, POLYSYMPOMATIC NEUROSIS,  
OR NERVOUS DYSPEPSIA.**

The term polysymptomatic neurosis answers to some purpose for the reason that the condition apparently is a mixed neurosis in which the sensory, secretory and motor nerve mechanism, either combined or alternately, may play a part. In this work, the term neurasthenia gastrica will be utilized for the reason that it relates to the etiology or causative state, the first and last terms above mentioned being more particularly connected with the symptoms. According to von Leube, the term nervous dyspepsia was intended to cover the group of cases in which the functions of the stomach were normal, while at the same time the patient was suffering from manifold digestive symptoms following the ingestion of foods. Of the cases manifesting changes in gastric secretion and motility, he makes a division into, first, nervous dyspepsia in which no anatomical changes are present in the stomach, and second, nervous dyspepsia in which the changes of gastric secretion are consequential to anatomical defect of the stomach nerves. To these Boas adds a third form of the reflex type from other organs, such as the kidneys, uterus, ovaries, male generative organs and the intestines. The term splanchnic neurasthenia has been used by me and may be employed if desired.

Adding to these the constitutional states (diabetes, tuberculosis, syphilis, anemia, debility, the general neural conditions of a functional nature), the organic stomach conditions (gastritis, ulcer), and the functional stomach conditions (hyperesthesia, gastralgia, states of low secretions of a neurotic nature, the hyper- and hypo- motilities of the stomach of a neurotic nature), it must be plain that the entire subject is much confused, and it might have been better had this condition as a clinical entity not been described except under stomach disorders. Still, cases of true neurasthenia gastrica do exist, and by the greatest care in clinical analysis a type of more or less primary neurotic disturbance of the stomach can be noted in which there is no demonstrable anatomical lesion, and which essentially is simply a neurasthenia affecting mostly the stomach and with it commonly the small intestine (gastro-enteric neurasthenia). Considering the functional disturbances, this type of disorder excludes the true sensory neuroses and the high and low secretory and motor condition already described, but it is my firm belief that those that do exist nowhere near make up the many cases that have been and are still being diagnosed as "nervous dyspepsia." Between true neurasthenia gastrica and the other neurotic gastric conditions the clinical distinctions are drawn

so fine that it is only as we view these patients from a neurasthenic standpoint, and following that only by a large number of gastric analyses, and long observation of the case, that those of true neurasthenia gastrica can be distinguished. It may be argued that such fine distinctions are impracticable or unnecessary. To this in a way I fully agree, for I understand that there is often little difference in the etiology, symptomatology, and even the treatment of the many phases of functional neuroses of the stomach (even more so than with functional neuroses met with elsewhere in the body). But the day is coming when many of the so-called cases of functional neuroses will be shown to have an anatomical or at least a chemical basis, and, since in some cases it is possible to diagnose true neurasthenia gastrica, the term should only be used to cover those that exist, and not all of the other types of gastric neuroses, a large proportion of which are only symptomatic of other conditions or what may be termed monosymptomatic neuroses, and also neurasthenia in general.

**Etiology.**—Any of the factors that would chronically deplete the general tone of body—diseased, constitutional, unhygienic, dietetic, or others—may affect the status of digestion in the stomach to the extent of causing variation in its function, a variation which *in toto* for diagnosis must be sensory, secretory, and motor, though not necessarily all combined at the same moment, but at least all present at different periods in a short space of time (within seven days). The more deeply these causative conditions assail the general state of body and the nutrition of the neural system most of all, the more numerous are the cases of neurasthenia gastrica and the fewer those of the simpler and more steady forms of other gastric neuroses. In my opinion, neurasthenia gastrica is never a manifestation or result of gastric disorder or abuse, or in fact that of any other single organ in the body, excepting as such disorders may deplete the general state of health and thus cause irregularity in the most sensitively balanced portion of the living economy—the digestive canal. The proof of this contention is seen in the fact that only about 10 or 15 per cent. of the cases of functional gastric disorders are those of true neurasthenia gastrica, and also the fact that the largest numbers are made up of the hardest mental or physical workers of the two sexes, namely, the men (in the women the more definitely primary or secondary forms of gastric neuroses are the most common). Neurasthenia gastrica may be looked upon as a disturbed physiological condition. When neurologists (who have searched long and ardently without success) find out what the pathology of neurasthenia is, if there is an anatomical one, it can be included in this gastric affection; anatomical

lesions or symptomatic states found only in the digestive canal will not explain all of them. Until that time, much of medical interest in all of the phases of the subject will remain obscured, and all that we can now say is that there are cases of neurasthenia in which the digestive symptoms are pronounced, and those of the general body slight or even absent in any observable way. Of interest in this connection is the report of Jurgens, who describes 41 cases of nervous dyspepsia in which at autopsy he found a total degeneration of the Meissner and Auerbach plexuses. According to this observer, when the symptoms were mainly sensory there was found a degeneration of the muscularis mucosa of the stomach and intestines, a pronounced formation of varices in the intestines, a degeneration of the muscular fibers of the veins and of the sensory nerves and of the branches of the Meissner plexus in this vicinity. Such findings, however, may also be noted in the cases which clinically appear as hyperesthesia gastrica, dilatations and prolapse, gastritis, and even the secretory disturbances; so they cannot be taken as distinctive of neurasthenia gastrica alone.

**Symptoms and Diagnosis.**—General neurasthenic states are characterized by a morbid irritability and fatigue of the psychical and physical processes accompanied by various sensory disturbances. In these, several groups of focal symptoms more or less combined in body make-up serve to picture the case. The cerebral and mental symptoms are seen in the psychical disturbances in the emotional sphere, and are characterized by a morbid irritability, apprehension, depression, morbid thoughts, lack of power of attention and thus consequential mental inability, and, in the symptoms of fullness and throbbing in the head, occipital headaches, and insomnia. Of the spinal symptoms may be described weariness on exertion, pains and tender areas along the spine, and the sexual disturbances of nocturnal emissions, impaired power, and dread of impotence. To these are added certain urinary and bladder symptoms, and the manifestation of vasomotor disturbance expressed in hot and cold flashes, localized sweatings and more steady heat and cold (usually of the hands and feet), transient blueness, cardiac pains, and irregular, rapid or slow heart action.

The gastro-intestinal symptoms comprise those noted in disturbances of the splanchnic area, which most probably are due to irregularity in the vascular, nutritive or sensory functions of the gastro-enteron. Clinically, they comprise no distinctive symptoms, and those that exist may be most variable. The most prominent and common ones are those of the sensory group coming on after meals, namely,

weight, fullness, ill-defined gastric, sternal, or back pains, burning or cold feeling in the stomach, and an empty sensation in the stomach even after a large repast. As a rule, these are not dependent upon the quality or quantity of food ingested, but rather upon the state of emotions and general body. Sometimes the most digestible foods cause distress, while the most indigestible are borne without discomfort. To the above may be added heartburn, eructations of inodorous and tasteless gas, sitophobia, digestive vertigo, and the intestinal symptoms of distention, abnormal sensations, flatulency, constipation, or thin, long, cylinder stools at one time and normal-shaped stools at another. The appetite is usually capricious, at one time buliminous and at another stage almost absent. A physical examination of the abdomen is often negative, but tender zones may be noted, as well as gas distentions in the cecum, colon, or sigmoid. A state of chronic excessive putrefaction in the intestines is a common factor in the production of neurasthenia.

The diagnosis of neurasthenia is made on the history in the way of noting the incongruity and inconsistency of gastro-intestinal symptoms, the more numerous cerebrospinal and vasomotor combinations with them, the observance of the patients, the variable course of the illness during observation, the length of time that it takes for recovery, and the stomach analyses. The more there is of the corporal symptomatology in the make-up of a case, the surer it is to be a general condition, because here the gastro-intestinal symptoms should be considered as part of the general picture. On the other hand, the greater the intensity of the gastro-intestinal symptoms, and the relatively fewer those of the general system, the surer it is to be a case of what may be considered as true neurasthenia gastrica. This latter in a way is a theoretical distinction, but it answers the purpose for clinical separation, for in so far as the gastro-intestinal symptoms are concerned, in both the more constitutional or the more digestive cases, separation is not always possible by special stomach analyses for the simple reason that the same stomach conditions are present in both. In an effort to clear the great amount of confusion that comprises the last-mentioned part of the subject, I want to state that to establish these diagnoses one must clear the field of all *bona fide* steadily functional, organic, or malignant stomach conditions, as well as those of the other organs accessory or remote to those of digestion. In doing this, practically every stomach condition other than truly neurasthenic states must be excluded. The cases of ulcer, gastritis, prolapse; a constant high, low, or absent secretion; increased or absent mucus, atony, or hypersensitiveness must be relegated to other pathological states than neurasthenia, although in the latter any or all of

these conditions may be present only for a short time. Now what sort of cases, in so far as gastric analyses are concerned, are truly neurasthenic? Only one type, in my opinion, and they are the ones that show more or less constant variation in gastric secretion, motility, and sensation. A case that shows a degree of changing in the quantities of acid-enzymotic secretion and states of motility, lasting a considerable period of time, is always a neurasthenia gastrica, and can be nothing else, and those individuals in whom the gastro-intestinal or corporal symptoms are intense and persistent, and numerous analyses show the process of digestion to be steadily normal are seldom those of clean-cut neurasthenia. A feature of great assistance in holding to the diagnosis of general neurasthenia is the fact that (even if there is a variation in the amounts of hydrochloric acid secreted at different times) the ferments are more often present in about constantly even amounts. The secretion of enzyme is much more independent of general conditions than the acid, and when influenced is more to be taken as an expression of a local condition. A rather cardinal symptom in splanchnic neurasthenia is a lower systolic blood-pressure in sitting than prone—sometimes the difference is as great as 15 millimeters of mercury.

**Prognosis.**—This is not always favorable, although, as a rule, it is good if the exciting cause can be removed, the general strength be built up, the treatments continued for a sufficient length of time, and the patient's financial condition is such as to afford the essentials of treatment. The milder forms yield readily to treatment, most of them requiring about a year of observation when this is conducted in the cities, and possibly half that time in sanatoria treatment in the country. Many patients, handicapped from birth with a weak nervous system, only do well when no especial demands are made upon them and an even tenure of life is carried out; for as soon as any physical or mental strain arises they go under. Other cases again, particularly in phlegmatic individuals with more or less abdominal organ prolapse, continue over long periods of time in fair health, but may easily progress on a downward path, lose flesh and strength rapidly, and have relapses on the merest provocation. All of these cases require the strongest persuasion on the part of the physician to have them maintain the essentials of treatment. The psychic spheres of the individual must be favorably influenced, and in accomplishing this the highest art and constant attention to details on the part of the attendant are required. The confidence of the patient must be gained, and the patient must more than feel that the physician is doing all that he can to cure him. The patient must also be made to do what he is directed to, persist in the details of treatment consistently; and assurance must be

given to all patients that they will eventually get well. Neurasthenics are the individuals who make up the ranks of the metaphysical vagans and creeds, and it might be better for us to harken to some of the results that these cults are obtaining rather than rail against them too strenuously. The functional disturbances of the brain are as worthy of our attention as physicians as are the functional disturbances of any other organ, particularly those of the psychotic or psychoneurasthenic type.

Treatment.—In all cases in which there are some other ailment these should receive first attention. The patient must be made to feel that recovery cannot be brought about by the use of drugs alone, and that measures of hygiene are of the first importance. Efforts should be made to strengthen the entire nervous system and physical forces. To these ends, change of climate, entire relief from business and perhaps social life, abundant foods, outdoor exercises, more fresh air but not too much sunshine, regular living, sufficient sleep, and hydrotherapeutic measures are essential. General body massage and electricity of any form are valuable adjuncts of treatment. No attempts at dieting to meet the gastric distress should be engaged in; in fact, the rule to follow is the giving of the largest amounts of foods of high caloric values, irrespective of the gastric symptoms. Tea, coffee, alcohol, and the stimulating foods should be interdicted, and the taking of supplemental meals should be encouraged. The gastric douche may be employed, as Rosenheim suggests, but no direct benefit to the stomach comes from lavage unless gastric hypomotility exists. The ferruginous or arsenical waters may be taken when indicated, or iron may be used in any of the readily assimilated forms. The bromides are necessary in the beginning to control the symptoms, but valerian and nux vomica bring about the best results in the end; the latter two should be continued over long periods of time. Nux vomica combined with the elixir of tincture of iron chloride and gentian, taken diluted before meals, answers best for the anorexia. When constipated, the bowels should be kept open by dietetic means, cascara, phenolphthalein, or enemas, but the purgative waters should not be used. To these ends there should be taken each day at least 4 glasses of water (1 warm before breakfast); fruits, raw or cooked, should be eaten morning and evening; the liberal use of honey, butter, olive-oil or fresh cream be encouraged; a dish of stewed prunes, sweetened with milk-sugar instead of cane-sugar, should be eaten before retiring, and the use of the bran gems (mentioned elsewhere), may be employed, with or without butter, at all of the meals instead of bread, rolls, or cake, and 3 or more to be eaten each day. Agar-agar may be taken with milk or cream and sugar with or in place of the morning cereal. Drugs from which there is a danger of the forma-

tion of a habit should never be employed in neurasthenia. A prescription of value is the following:—

R. Fluidextracti cocæ,			
Tinctura nucis vomicæ .....	āā	8.0	fij
Acidi phosphorici diluti .....		24.0	fvj
Syrupi zingiberis .....		45.0	fiss
Aqua menthae piperitæ .....	q. s. ad	300.0	fvj
M. et ft. mist. Sig.: Tablespoonful in water after meals.			

The daily administration by hypodermic method of a solution of cacodylate of soda, strychnia or iron with glycophosphates, the same kept up about a month, is the best medical treatment I know of. The malt preparations are excellent constructive tonics in all neurasthenic states.

#### BULIMIA.

Bulimia is the condition characterized by an abnormal feeling of hunger, and it may be the only manifestation of a primary neurotic condition affecting the stomach, or it may be associated with various other affections. Of the latter may be mentioned particularly ulcer of the stomach, hyperchlorhydria, dilatation of the stomach, neurasthenia, hysteria, tapeworm, pancreatic and intestinal affections, brain tumors, Basedow's disease, pulmonary tuberculosis, diabetes and syphilis. Its duration depends upon the cause, the primary forms usually disappearing suddenly, the secondary forms continuing according to the nature of the illness. A number of theories as to the origin of this symptom have been advanced, all of which still remain to be proven. Of these, however, that of Knapp of contractions of the muscularis of the pyloric region is most interesting, it corresponding to the relief of the symptoms when food had been taken but not to the primary cause, which, as was stated before, may be central or constitutional. Knapp states, "As the contraction of the muscularis is the result of irritation of the mucosa, consequently the irritation of the mucosa at any time will produce contraction, which will give rise to the sensation of hunger, and, as soon as the contraction gives way to relaxation, the sensation of hunger disappears." The condition is most commonly found in women, in the proportion of four to one.

Bulimia occurs in periodical attacks lasting for a short space of time, or it may be chronic. In the neurotic form, which is the most intense type, a feeling of intense hunger occurs with a persistent desire to overcome it. From the gnawing sensation in the stomach, there occurs a degree of fear and anxiety and, unless food is quickly taken, the patient becomes exhausted, feels faint, has ringing in the ears, and suffers from vertigo, headache, trembling and cold extremi-

ties. When the condition continues, the patient usually consumes enormous amounts of food in a day in a constant effort at satisfying the intense hunger. As a rule, the secretion and motility of the stomach are normal, but these may be abnormally influenced for the time being. The prognosis depends upon the cause, the neurotic form accompanying neurasthenia or hysteria sometimes disappearing rather suddenly, but in extreme cases this may be protracted for some weeks or months.

The treatment depends upon the primary cause. In the acute and distressing cases, the hourly taking of light meals, the giving of large doses of bromides, or an initial dose of opium would be helpful in controlling the symptoms for the time being. These cases, particularly, should always be thoroughly examined in the search for some primary cause, and when present the other conditions found should be systematically treated. In the neurotic form the patient must control the amount of food taken and the case should be treated as a neurasthenia.

#### PAROREXIA.

Perversions of appetite manifested in a desire for unusual foods have been divided into: (1) pica, desire for articles of the non-food character, such as coal, ashes, earth, chalk, sand, insects, etc.; (2) malacia, desire for special or pungent foods, such as vinegar, mustard, spiced sauces, catsup, green fruits, etc.; (3) allotriophagia, desire for disgusting or harmful substances, such as urine, feces, glass, needles, pins, knife-blades, etc.

Pica and malacia are often observed in the same individual in neurasthenia, and allotriophagia is noted in hysteria, idiots and lunatics. Malacia is frequently noted in chlorotic girls and pregnant women and to an extent is symptomatic of these conditions.

#### POLYPHAGIA.

Polyphagia denotes that condition in which excessive amounts of food are required in order to satisfy the feeling of hunger. The symptom, in my observation, is not an unusual one in cases of more or less chronically dilated or large stomach observed in certain females, generally of the very slim type. It may be noted as a primary neurotic disturbance, but is also seen in some cases of brain tumor, cancer of the pancreas or spleen, diabetes, convalescence from diseases which have been attended with fever, a few cases of gastritis, and fistulous opening of the gall-bladder. Like bulimia, it may be

paroxysmal or permanent, and the neurotic form is treated in the same manner.

#### AKORIA.

By akoria is meant the absence of the sensation of satiety following the ingestion of large as well as small meals. Clinically different from bulimia and polyphagia, the appetite may not be increased and may even be diminished. Like the other symptoms of this group it is observed mostly in the cases of neurasthenia and hysteria, or associated with other diseases, mainly diabetes or disorders of the male sexual organs. A neurotic form of the stomach may occur, but it is rare, because a gastritis or an atonic stomach is generally found to account for the symptom.

#### GASTRALGOKENOSIS.

Boas has introduced this term to indicate the neurosis characterized by the appearance of pain in the stomach when it is empty and disappearing as soon as food is taken. The symptom is a common one in hyperacidity and hypersecretion, but Boas claims to have observed a case in which a large secretion of hydrochloric acid and yet hyperperistalsis and hyperesthesia did not exist. He believes that the symptom is due to abnormally severe contractions of the pylorus, which become severer toward the end of digestion after the liquefaction of the ingesta, and probably become retarded after new introduction of food. Other than in neurasthenia and the hyperacidities, I agree with Hemmeter that the symptom is an expression of hyperesthesia. Clinically, in most of these cases a thorough purging will cure or at least relieve the case.

#### ANOREXIA NERVOSA.

A remarkable loss of appetite is seen in some cases of hysteria, in which the desire for food is absolutely lost perhaps for long periods. This symptom is more commonly noted during the course of pyrexia, in debilitating and wasting diseases; in cancer, suppurations, and tuberculosis, and many other forms of gastro-intestinal disease. It may occur as a primary affection following a severe mental shock, in which it usually rights itself in a few days unless a condition of continued mental depression sets in. In the neurotic cases the appetite is gradually lost, the patient eats less and less, and eschews the solid foods first and then the others. If the condition is continued, the patient loses weight and strength, and becomes anemic, and a few cases ending in death have been reported.

In the cases of a nervous type, in fact in any form, treatment is essential. The patient should be impressed with the idea that he must take food, and every effort should be made to supply food in some form. A liberal variety of articles may be allowed, and regular attendance at the table at meal times should be encouraged. *Nux vomica*, *condurango*, *gentian*, *cinchona* and other bitter tonics should be given, well diluted, five or ten minutes before meals. In the more severe cases isolation becomes important, the gastric douche, or intra-gastric galvanism may be used, and perhaps feeding by stomach-tube or nutrient enemata may be essential. In such cases, any form of stomach treatment in which the tube is used gives one a marked advantage, because, after the spraying or lavaging and before the tube is withdrawn, the running down through it of a mixture of several eggs in milk with sugar, if done often enough, will maintain the status of nutrition and add weight. The tonics should be given, and the treatment should be persisted in until the former weight has been regained. Rather large-sized doses of strychnine are an important adjunct to the treatment.

#### NAUSEA NERVOSA.

Under this term is described a purely functional form of nausea occurring in neurasthenia, hysteria and some cases of anemia. As a symptom, nausea is observed in most gastric affections, and these need not be dwelt upon here. According to Boas, the functional type is caused by a condition of changing blood circulation in the brain. This seems to be a reasonable explanation, because such is no doubt present in the conditions in which it is seen, namely, the functional neural conditions, menstruation, menopause, chlorosis and anemia, worry, fright, anxiety, etc. In these cases results from the gastric analyses are generally negative.

The nausea may be intermittent or continuous. In the first, the condition comes on independent of ingestion and may occur at any time of the day or night, the attacks lasting from a few minutes to several hours. The continuous form persists for lengths of time, possibly for months, in varying degrees of intensity depending upon the general condition of body and mental state. As a result of the loss of appetite the patients usually partake of limited amounts of food and become run down in strength, and emaciated. There are few more trying cases to deal with than neurasthenia or hysteria with nervous anorexia, and it is fortunate that these are not numerous, at least in a pronounced form. I had a trained nurse under observation who, as a

result of four months of trying night work in a hospital, developed neurasthenia with pronounced continuous nausea. Although at the time of treatment she was living under more favorable conditions, the nausea prevented efforts at feeding, even to the extent of maintaining her equilibrium of weight, and thus she made a steady loss of about three pounds in a week. Altogether she lost 29 pounds in about three months' time, and did not recover until the rest cure supplemented by regular feeding by lavage had been instituted. While she was about, all efforts at feeding, controlling the nausea by drugs, or creating an appetite by means of tonics, bitters, gastric spraying and galvanism, were fruitless. In every way she was a willing patient, but even the thought of food brought on an intense nausea, vertigo, trembling and various vasomotor disturbances. The treatment in the intermittent and continuous forms of a neurotic type is that of feeding by whatever means possible, together with the treatment of neurasthenia. When nausea is a symptom of some definite form of disease, the treatment is that of the primary affection, with possibly the bromides, valerian, sumbul, or validol added.

#### SITOPHOBIA.

This term was first introduced by Einhorn to indicate a condition of hyperesthesia in which fear of food develops, and in which, if the condition continues, the dyspeptic symptoms gradually increase even after taking the smallest amounts of food. In consequence, the patient develops various neurasthenic symptoms, anemia, and inanition. It is probable that all of the severe cases are neurasthenic or hysterical in origin in the first instance, and that the hyperesthesia gastrica is a manifestation of the general conditions. The symptom of lesser degrees of sitophobia is, of course, commonly present in sensitive states of the stomach for any reason, among which conditions may be mentioned gastric and duodenal ulcer, cancer, gastritis, hyperesthesia gastrica, gastralgia and enteralgia, chronic constipation and chronic diarrhea. According to Einhorn, a true "phobia" condition is due to an abnormal fear, psychic in character, and therefore of cerebral origin. There is no very definite reason to believe that the condition is a clinical entity even in the functional form.

On account of distress or pain, the patients give up the taking of one food after another until the diet is restricted along very contracted lines, and possibly only semisolid or fluid foods are taken. The result of this is seen in the inevitable effects on the general state of health, tone of body, loss of weight, and anemia. Only very small amounts

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of food may be taken each day, and instances of fatal issue have been reported.

The one essential of treatment is to insist that the patient make every effort to take nourishment, even though it produces distress or pain. In a short time it will be noted by the patient that foods which had caused distress before were then being tolerated with comfort. Supplemental fluid foods (milk, eggs, cream) should be given, and the quantity of solid foods increased until meal tolerance is acquired. Two weeks' confinement in bed may be necessary in the beginning and hot or cold applications or daily galvanism may be used to control the gastric distress. The bromides, small doses of chloral, belladonna, the alkalies or valerian may be necessary. The treatment is essentially that of hyperesthesia and hyperchlorhydria combined. In practically all cases cure is eventually brought about.

## CHAPTER XXXI.

### Functional Disturbances of the Stomach. *(Continued.)*

#### DISTURBANCES OF MOTILITY.

##### MYASTHENIA GASTRICA AND ATONIC ECTASIA.

###### Classification of Primary States of Deficient Gastric Motility.

AMONG the synonyms that have been used for these conditions are gastric atony, motor insufficiency of the first degree, muscular insufficiency, gastric insufficiency, myasthenia ventriculi, hypomotility, gastric relaxation, gastrectasia, and others. The above terms have been selected by the author for the reason that gastric myasthenia is more expressive of slight states of lowered muscular power (hypomotility) in which delay in the exit of foods is but little or not at all a feature, and that atonic ectasia can be used in definite contradistinction to secondary ectasia because the latter is more expressive of marked gastric relaxation rather than just functional weakened power like myasthenia or primary atony. The author hopes, in his effort to simplify the nomenclature for clinical purposes, that more confusion is not added to this already much confusing subject. The first term pertains particularly to weakened power, the stomach not being increased in size; the second to slight states of relaxation in which the organ is very little increased in size; and secondary ectasia (or dilatation) to the much enlarged and thinned out organ due to obstructive conditions interfering with the exit of chyme. Atony from mechanical reasons will be described under secondary ectasia, and under acute post-operative dilatation of the stomach and intestine.

**Etiology.**—Cannon has shown that the ordinary physical changes expressive of emotion are mainly superficial, manifesting themselves at the periphery and occurring chiefly in the structures supplied with the unstriped muscle fibers and innervated through the sympathetic system. It seems to have been proven beyond peradventure of doubt that states of emotion, worry, fright, anger, etc., not only affect the superficial structures but also the similar musculature and nervous supply of the viscera in which these muscle fibers make up large component parts and are intimately connected with organ function.

While certain functional disorders of the bladder and heart are common examples of the effect of the state of mind upon other organs, they are fewer in number and less in extent than similar states in the digestive canal. A practising physician need not investigate the literature to verify this statement, because ordinary everyday experience demonstrates that this intimate association exists in individuals who are not neurasthenic or hysterical in nature. In recent physiological studies of the alimentary canal the importance of emotional states to normal digestion has received striking confirmation, not only of the motor, but also of the secretory activities. Homborg was able to show that the psychic effects of the appearance and taste of foods, shown to exist in the dog by Pawlow, also occurred in the human being. Cannon has noted in the cat that any sign of rage or distress or mere anxiety was accompanied by a total cessation of the movements of the stomach, and that this condition persisted for some time afterward, and also that what was true of the stomach was also true of the peristaltic waves and segmenting movements of the small and antiperistalsis of the large intestine. He believes, deducting from animal experiments, that the vagi convey to the stomach not only the motor impulses generally attributed to them, but also the inhibitory impulses, although the splanchnics are the main carriers of the inhibitory stimuli.

Important also in the consideration of myasthetic and atonic states of the stomach is a knowledge of the influence of intragastric pressures upon the motility of the organ. Cannon has shown that mechanical stretching is a most efficient stimulus for exciting activity in smooth muscle, and, since this type of muscle fiber surrounds hollow organs, which gradually fill and must be emptied, the value of distention as a stimulus is obvious. When an organ with walls of smooth muscle is flaccid and toneless, distention calls forth no response, and this is true in the atonic stomach and colon. Only when the muscle is shortened and resilient—in a state of tonus—does stretching result in a contraction. Between the large cardiac and small pyloric ends the relations between internal pressure and tonus will be intermediate, and at some point the relation will be suitable for a contractile response, which is a point shifting toward the pylorus by increasing internal pressure, or almost to the fundus by decreasing that pressure. Cannon states: "The view that tonicity of the neuromusculature of the alimentary canal is a fundamental necessity for the appearance of rhythmical movements harmonizes many diverse observations. It accounts for the failure of efficient motility in atonic states of the stomach and intestines. It gives a reasonable explanation for the existence and importance of extrinsic motor nerves. It is in agreement with the observation that tonic contraction and

rhythmical peristalsis disappear together in cases of general bodily weakness, when the depleted central nervous system may be supposed to fail to deliver the necessary tonic impulses; it is also in agreement with the observation that worry, anxiety, and distress stop gastro-intestinal movements, for such states, accompanied by splanchnic impulses, abolish tonus. It fits admirably with the fact that the stomach of hungry animals is strongly contracted, for then the tonic state makes the organ ready for instant action on swallowed food. Indeed, I am inclined to believe, for reasons which time does not now permit me to develop, that the sensation of hunger results from tonic contraction of the empty stomach. These are only some of the conditions in which the importance of tonus for movements of the alimentary canal is manifested; doubtless, other conditions will suggest themselves."

It will thus be seen that acute mental states have a powerful influence on the status of motility and secretion of the gastro-enteron. Added to these there is much clinical reason to believe that less acute and more continuous mental states of an emotional type account for many of the dyspeptic disorders that are seen. The baneful effects on the general system noted in such individuals must have some relational connection with the status of digestion. Worry, suspense, anxiety, business and family troubles often show their results in loss of appetite, digestive disturbance, loss of weight and strength, anemia, irritability, various pains, insomnia, and constipation. It is probable that these are partly brought about by chronic states of lessened motility in the digestive canal (hypomotility or myasthenia). Such conditions, when continued over great lengths of time, may start up a vicious circle by the formation of gases and decomposition products and affect the stomach and general system to such an extent that mild degrees of true gastric atony are eventually established. True neurasthenia and atony have no anatomical lesion in the stomach.

The causes of myasthenia and atony may be described in the following divisions: 1. Psychical states of short duration causing states of lowered or absent motility, and psychical states of a chronic character causing definite myasthenia and atony. 2. Consumption of large quantities of indigestible foods or much fluid. Among these may also be mentioned indiscriminate mixing of foods, excessive use of stimulating condiments, coffee, tea, alcohol, or soups. 3. Excessive gas collection in the stomach, such as are seen in cases of sensory neurotic disturbance, gastritis and malignant disease, and states of reduced acid and enzymotic secretions. 4. Atony, secondary to other constitutional diseases, among which may be mentioned tuberculosis, typhoid fever, brain and cord diseases, disease of the intestine, cholelithiasis, disease

of the generative organs in males, heart affections, anemia, debility from any cause, neurasthenia, diphtheria, and influenza. 5. Congenital cases or those which exist from infant days and originated from mal-nutrition, rickets, or scurvy. 6. The secondary forms due to gastric ulcer, perigastric adhesions, gastrophtosis, enteroptosis, chronic gastritis, gastro-enteritis, chronic constipation and malignant disease.

The author has shown that chronic toxic intestinal conditions are most prominent factors in the production of atonic states of the stomach and colon. This is brought about by the toxins causing a granular degeneration of the cells and neurons of the sympathetic system, in that way cutting off to an extent the nervous balance with an ensuing atony. These resulting conditions are commonly met with in indolic and the mixed types of chronic intestinal toxemia.

**Symptoms and Diagnosis.**—The diagnosis of myasthenia gastrica to a great extent is more or less suppositional in all cases. The fact is there are no definite or distinctive symptoms, either subjective or objective. The diagnosis may be made in cases which have developed digestive symptoms after a long period of mental strain and who show a low state of gastric secretion; in the dietetic cases which have for years gone on with improper methods of feeding and gradually developed digestive symptoms; those in whom irritative states of the stomach can be excluded (hyperesthesia, excessive secretions) and in whom test-meals are not significant in other ways and the motility tests show only a slight retardation of foods or are negative; cases in which gas collection in the stomach has existed over long periods of time and the tests for primary conditions are negative; when the X-rays show a slightly enlarged organ; in states referred to the stomach from disease in other organs; and in the constitutional conditions when the gastric analyses are not significant in the way of showing primary gastric disease.

The diagnosis of true primary atony is much more definite. Here we can take advantage of the series test-meal analyses with the mixed meals, and figure on the solid and fluid returns from the simple meal. In atonic ectasia a moderate degree of stagnation or retardation is observed, which is definite, but never as pronounced as in secondary ectasia. The returns from the Ewald meal show larger quantities than normal of solid and fluid contents, not separating into the characteristic three layers seen in secondary ectasia; not containing yeast spores, sarcinas, Boas-Oppler bacilli, lactic acid, or blood, the fluid containing a normal total amount (not relative proportion in a small amount of filtrate) of hydrochloric acid and enzyme, and perhaps a hyperacidity in the early stage of the case, but which eventually reduces. The mixed or Reigel meal method of examinations is the most valuable.

although the fractional may be employed too. Accepting as a fact the statement that a normal stomach should practically be emptied of a mixed meal five hours after its ingestion (excepting a few remnants), when large amounts of meat, potato, and bread are obtained five, six, or seven hours afterward it is plain that we are dealing with either a disturbance in the muscular power, or a pyloric obstruction, or both together. Since the status of secretion is always important in the diagnosing of gastric affections and the examinations for this in the mixed meals requires rather extended laboratory procedure and considerable knowledge as to the significance of the results obtained, I have adopted a simpler form of procedure for the diagnosis of states of primary atony that answers to good purpose. It must be recalled that, when gastric stagnation is present, an empty morning stomach after cellulose substance ingested the night before usually means primary atony or that a mechanical obstruction is some distance away from the pylorus itself, and that when the cellular substance is found true states of pyloric obstruction exist. This means of separation is a valuable clinical method by which to distinguish the cases. On this basis I have employed a modification of the cellulose method combined with the Ewald meal, or the fractional meal, so that the examination can be made during the day and at one sitting for learning both the state of motility and the state of secretion and still have a simple medium to examine for the latter.

The time of taking the prunes or raisins is marked upon the card according to the time of the extraction later of a mixed meal (5 or more hours), the Ewald meal being taken one hour before extraction. Under normal conditions none of the wood fiber from the prunes or raisins should be found in the stomach, and such as is present is easily noted and does not interfere with the analysis of the Ewald meal or its return through the tube. There is one type of case of atony that may give negative findings in this procedure, and may give test-meal indications like those seen in hypermotility. A marked atonic stomach in which the pylorus is also relaxed generally gives a small test-meal return, perhaps with a low acidity, and always with an absence of the cellulose substance. In these, of course, one must depend more upon the history and the physical examination for diagnosis. These stomachs are usually large and somewhat globular, although the dilatation may be limited in location and the rest of the stomach of normal size (by X-ray).

The subjective symptoms most commonly present in these cases are: loss of appetite or a feeling of satiety from the smallest amount of foods, distress in the stomach after meals which lasts for from one to four hours, greater degree of distress on taking fluids than solid foods, pyrosis, nausea, regurgitation, but rarely continued vomiting, belching

of either tasteless and odorless gas or that tainted with the taste of the foods taken hours previously, constipation, headache, vertigo, nervous symptoms of various kinds, palpitation of the heart and indefinite cardiac pains, difficult breathing, and, in the forms secondary to nervous or constitutional disorders, a ravenous appetite may be present. Of these, gastric vertigo (vertigo stomachal) is a distinctive feature in many cases.

In instances of myasthenia gastrica the physical examination of the stomach is generally negative in every way. In atonic ectasia the stomach is found to be enlarged and lax. The vertical dimensions in all areas of the stomach show a moderate increase in size, and the greater curvature in the prone position reaches to the umbilicus or below in the males and always below in the females; note must be taken that the shape as well as the size of the organ is mapped out so that an atony is not diagnosed for gastrophtosis; however, more or less atony is generally present with the latter, although of course it is always secondary in nature. On inflation, the stomach can easily be mapped out by percussion or auscultatory percussion, and its size and shape noted. Splashing or succussion sounds are most valuable to diagnosis, particularly when these are present some hours after a full meal. Water may be given at the time of examination and the splash noted, but it is only when the splash is loud and easily produced that the sign is of any value. If the abdominal walls are very thin and relaxed the borders of the stomach, particularly the greater curvature, may be indistinctly palpable or visible through the abdomen. Gastrodiaphany may be employed, but the X-ray bismuth or hourly X-ray food methods answer to far better purpose. These patients are usually in a poor state of nutrition, and when young are anemic.

Atonic ectasia must be differentiated from secondary ectasia, gastrophtosis, certain nervous disorders of the stomach, neurasthenia, megalogastria, and chronic gastritis.

**Prognosis.**—States of simple myasthenia usually correct themselves when the local and general conditions of the body are improved. Atonic ectasia is essentially chronic, although the course and variation depend largely upon the ability of the patient to carry out a sustained course of treatment, the recuperative power of the individual, and when present the results of treatment of an underlying condition. Those accompanying gastrophtosis are often the brightest results that are obtained. The atony can pass into definite states of relaxation, but this is rare. However, when it does occur the prognosis for permanent relief is unfavorable in the extreme.

**Treatment.**—Certain constitutional and infectious diseases may be contributory to states of myasthenia and even atony. The closest supervision is required in the convalescence from these cases, as well as in those who have a congenitally weak condition of the muscularis of the digestive canal. Since atony is frequently caused by injudicious and too rapid eating, poor mastication, too much drinking of fluids, the excessive use of tea, coffee, alcohol, and tobacco; incorrect method of life, and the habitual use of purgatives, these should receive attention. The patients are usually poorly nourished, neurasthenic and anemic, and thus require a general mixed diet and superalimentation. Care must be exercised, however, that the stomach is not overburdened with food at any one time, and thus frequent feedings or supplemental meals are required. Not much attention need be given to the status of secretion unless this is markedly hyperacid. In that instance the diet recommended in the early treatment for excessive secretion should be instituted, but the patients should not eventually be placed upon only the carbohydrate and hydrocarbon diet as advised in that connection. When the symptoms are relieved, or in some cases in the first place, the diet should be dry as possible, only enough fluids being allowed as would allay the thirst. Of these, the best foods are the various meats, poultry, game, fish, eggs, cream, butter, peas, beans, lentils, and the well-cooked and mashed or strained vegetables. If milk is well borne, not more than 4 glasses a day should be allowed, and these should be reinforced with fresh cream. The cereals can be taken, but fruits, berries, and green vegetables are not safe foods to employ. Cocoa or chocolate made of milk should be substituted for other beverages, and all gaseous or alcoholic fluids should be avoided. Olive-oil may be employed, and certain foods suggested in the diet for constipation often serve to good purpose. The simple cheeses may be taken, but never the pungent forms. The caloric value of the day's diet should always be above 2500, and later on in the treatment nearer to 3500 calories are better. The foods should be cut very fine on the plate and then well chewed before swallowing. The diet is essentially that for gastrophtosis.

Of the special treatments, lavage should never be employed, unless there is a definite indication for its use, such as in chronic gastritis. Stagnation is rarely enough a feature to require stomach washing and the fermentation or neurotic gas collection cannot be stopped by it. More than that, it adds a dead weight to the stomach and further weakens the musculature. If the apparatus and technique are good, gastric douching may be of benefit, but water collection must be guarded against. At these times cold or quite warm water answers

to good purpose and it makes but little difference what character of solution is employed. Intra-gastric faradism with slow vibrations or the sinusoidal currents are valuable adjuncts to the treatment. The external electrode method may also be employed, but it is not preferable. When the symptoms of distress are marked the galvanic currents with the positive pole internally may be employed, but the faradic currents are the best to tone up the muscle walls. In these cases a good battery capable of delivering both the faradic and galvanic currents at the same time (combined currents) answers to good purpose. Séances should last from ten to fifteen minutes, the faradic current should be used to tolerance and stronger on the back than the front, and the galvanic current from 10 to 25 milliampères. From 15 to 20 treatments, at the rate of two or three a week, are sufficient to obtain a marked improvement. After this has been done, in constipation cases, the colon can be treated by the currents, or electric vibration or massage can be added to the routine. Matters of hygiene and a strengthening régime should be advocated. These are the cases which systematic exercise of a light character benefits most signally, such games as handball, boxing, squash, fencing, tennis, and golf serving to good purpose. The morning sponge or cold rub is serviceable and the patients should not do too much brain work or be too much confined indoors. Women who have primary atony and become pregnant should be watched very closely, kept in bed three or four weeks after labor, nourished very well, bandaged properly, exercised to strengthen the abdominal muscles, and be more or less under the physician's care during lactation. When patients can afford it, an annual midsummer and midwinter vacation should be advised.

When a chronic gut condition is present this must be properly treated or the symptoms will continue or quickly return.

The best drug to employ is strychnine or *nux vomica*. This should be given throughout the treatment and in the largest-sized doses that can be tolerated. Belladonna or the oils can be used to control hypersecretion, but bicarbonate of soda should not be employed as an antacid. The bowels should be controlled by diet, enemata, cascara or phenolphthalein. The anemia is best treated by dietetic means and the use of the readily assimilated non-astringent forms of iron. Valerian is of service when the neurotic symptoms are marked, but it is best not to use the bromides. A prescription that answers to good purpose when the atony is accompanied by anorexia and neurosis is the following:—

B Tincturæ nucis vomicæ,  
Tincturæ valerianæ,  
Fluidextracti condurango ..... 10.0 ʒiiss  
M. et sig.: Take one-half a teaspoonful (30 drops) in water after  
meals.

#### SECONDARY ECTASIA.

Motor insufficiency of the second degree (Boas), insufficiency from obstruction, chronic gastrectasia, dilatation of the stomach, acute gastrectasia, etc., are stagnation or retention states of the stomach secondary to mechanical obstruction in the pyloric region. An idiopathic non-obstructive primary form (not post-operative) has been described, but this is too theoretical for practical purposes. Still it is possible that acute dilatations of the stomach may occur as a result of the drinking of large amounts of fluid, but this is only a temporary condition. The post-operative dilatations (paralysis) will be described in the next division.

**Etiology.**—As to whether states of primary atony, even in extreme conditions, ever go on to marked degrees of gastric stagnation, opinions differ. Clinical experience teaches that the degrees of stagnation produced in mechanical obstruction are never seen even when the musculature is in a general state of atrophy, colloid or fatty degeneration, or when penetrated by diffused carcinomatous masses away from the pylorus. Excepting post-operative paralysis, mechanical obstruction is always necessary to produce this type of the organ.

The pylorus or the pyloric region of the stomach may be constricted from within or without. Of the inside conditions are the cicatrices of more or less healed ulcers causing a bridging of the lumen, or a contraction in the circumferential diameter of the lumen and a deformity of the stomach without seriously impairing the full diameter measurement, and various irregular combinations of the foregoing three; malignant disease causing narrowing of the lumen by the carcinomatous masses extending into the cavity of the organ and the resulting stiffening produced in the walls; continued pylorospasm interfering with the exit of foods; hypertrophic pyloric stenosis due to thickening of the musculature and contraction of newly formed fibrous tissue in the walls; foreign bodies like resin balls, hair balls, cherry or peach stones; the pedunculated benign tumors, and kinking of the prolapsed organ at the duodenal anchorage. Of the outside causes may be mentioned perigastric bands stretching across or drawing upon the organ and causing deformity, such as may be seen following ulcer, gastritis, cholelithiasis, omental adhesions from appendicitis, liver, infective gall-bladder conditions, pancreatic cysts pressing upon the

duodenum, movable kidney particularly following unsuccessful operations of anchoring, floating spleen pressing upon the duodenum, dermoids, and enlarged glands or masses below an indurated ulcer pressing the two sides of the stomach together and generally found in the posterior wall away from the pylorus.

**Symptoms and Diagnosis.**—The subjective symptoms are those mentioned under atonic ectasia, to which are added malnutrition and other definite manifestations according to the disease or condition present. In the secondary ectasias, however, the gastric symptoms are always more of a feature and often most intense. Vomiting, and particularly that of the collective or stagnant type, is a symptom of the greatest importance. In the benign cases or even those of malignant disease not obstructing the outlet much vomiting may occur, but doubts may exist as to whether this is significant. It is evident that, when the stenosis is not marked or a spasmodic element exists, a fair degree of patency is present, and, when fluid foods mainly are taken, vomiting may not be much of a feature and collective vomiting not be seen. This symptom and those of the grades of stagnation depend altogether upon the degree and permanency of the stenosis and but very little upon the condition of the general gastric musculature. Pains are more marked in secondary ectasia than in the primary forms. Tetany or choreiform movements may exist.

On examination of the patient more or less loss of weight and emaciation are commonly discovered when the stenosis is marked and permanent. In the benign conditions, and even sometimes in the malignant, a fair degree of body nutrition may be noted, particularly when a fluid diet heavy in proteids had been taken for a length of time. It is sufficient to report that even in cancer high proteid fluid feedings may cause the addition of weight for the time being; this depends upon the location of the disease in the stomach, its extent and type, namely, as to whether we are dealing with the soft or hard form. When the emaciation is distinct and the stenosis is marked, inspection may disclose peristaltic or antiperistaltic waves running over the organ from the costal margin to the median line; of all diagnostic signs connected with secondary atony these visible peristaltic movements are the most valuable, for up to this time, my experience has been that when they are present organic stenosis of a high degree almost always exists. Sometimes in a very large and distended organ, a fullness or bulging of the left upper quadrant of the abdomen may be noted and even the extension of the greater curvature be seen. Percussion or auscultatory percussion or palpation may be negative if the stenosis is slight, or may be valuable in the way of noting a largely dilated stomach. The splash sounds are almost always present, slight

and indistinct in slight stenosis, and marked in the severe grades. The gastrodiaphane or, better still, the X-ray bismuth method of examination will display a large, globular stomach enlarged in all of its dimensions, and the hourly X-ray food method would be helpful in noting grades of delay in the exit of foods; sometimes only the pyloric region seems to be dilated, the rest of the stomach appearing normal in size. The gastro-scope may be used, but, as it is usually impossible to get the pyloric region and pylorus into view, it serves to no value unless there is a formation of malignant disease extending into the body of the organ.

The examination of the stomach contents yields the most important results for diagnosis. The examination of the vomitus may or may not give definite conclusions, depending upon the degree of stenosis, its permanency, its pathological character, and its location. In slight degrees, particularly in the benign conditions, nothing of importance can be gained and the employment of the hourly mixed test-meal analyses is essential. In several grades, the large, dark-gray or brown achylic return, with lactic acid, blood, pus, long-retained food particles, a fluid which separates into the three layers on standing is characteristic of that due to malignant disease. The vomitus may be very fetid, and considerable subjective relief is generally experienced when the organ has been emptied. In lesser degrees of stenosis, particularly in the non-malignant conditions, great dependence can be placed upon detailed observation of the test-meal method of diagnosis. In ulcer and other benign conditions the hydrochloric acid may be normal in a unit of quantity, and the meal have increased amount of bacteria giving more than 2 per cent. gas result (Ewald meal) in the fermentation tests. At the end of five hours after a mixed meal (when the normal stomach should practically be empty) quantities of red meat fibers and the other foods are obtained, and as these in quantities run through the six-, seven-, and eight-hour extractions, the various grades of stenoses can be judged. In high degrees of pyloric stenoses the morning stomach after a mixed meal given the night before usually contains some of the food, and the simple testing method of Mayo is very valuable toward these ends. Employing aspiration, an acid return with food, with or without blood (occult or macroscopic) or mucus and free from lactic acid and the lactic acid formers, argues in favor of benign stenosis, either intra- or extra-gastric in origin. In all stenoses the test-meal returns are bulky, depending upon its degree. The presence of many sarcinas argues in favor of benign stenosis rather than cancer, although the yeast fungi may be found in both. These points are dealt with in detail under the subject of gastric analyses of the various conditions.

In high degrees of stenosis the urine is diminished in quantity. Some have classified the grades according to the amounts secreted, claiming an output of 1000 to 1500 cubic centimeters for the mildest; 500 to 1000 cubic centimeters for the medium, and under 500 cubic centimeters for the severer grades. In making these examinations the day's collection should be started with a lavage of the stomach in the morning and at the end of twenty-four hours an aspiration of the stomach should be made. It is evident that as much fluid as a normal person would ordinarily take should be out of the stomach by noon and be represented in a daily output of over 1500 cubic centimeters. Naturally, with a patient in bed, the greater the discrepancy between the intake and output of fluid, the more significant this would be.

Such urines may be alkaline in ulcer and acid in cancer. A phosphaturia or albuminuria may exist, and acetone and diacetic acid be present. Acetone urines are more common in ulcer than cancer. The blood usually shows an anemia, represented both in a diminution of the hemoglobin and the number of red cells.

Heinrich Landerer in 1879 reported a series of 9 cases of congenital stenosis in the adult, varying in age between forty-three and sixty-three, in which at autopsy he could demonstrate a narrowing of the pylorus and which he believed to be of congenital origin. Since that time Maier, Maylard and others have reported cases; so there is little room for doubt that this is a correct interpretation of the lesion. These cases usually give a history of chronic gastric distress and evidences of mild or moderate degrees of stagnation or retardation of foods. The recognition of this clinical entity is particularly interesting in the light of similar lesions in infants whose clinical manifestations are now quite familiar, and will be found described elsewhere. together with the adult cases I have seen, which had very much enlarged organs with seven- and eight- hour large test-meal returns after the mixed meals. These adult cases require pylorectomy or pyloroplasty as the operations of choice, very few of them being permanently relieved by gastro-enterostomy as strange as this may seem. This latter is probably due to the chronic course of the condition and the fact that the tendency is for the food to follow the normal exit and the gastro-enteric opening is liable to close in about a year's time.

The differential diagnosis rests between atonic ectasia and other forms of gastric disturbance, dilated colon, prolapse, neurasthenia gastrica, gastric crises, the esophageal conditions, and the various types or character of stenoses. These are described under the various disorders. Very often, particularly in the slight or medium

grades of stenosis, all we can conclude is that a degree of permanent stenosis exists (which for many cases is a perfectly practical and complete enough diagnosis), and it is necessary for surgery to find out just what its character or source may be.

**Prognosis.**—In the early stages of secondary ectasia one should be exceedingly careful to guard against too definite assertions as to the cause and outcome of the affection and the results from treatment. These cases should be carefully analyzed and closely watched, and resort made to surgery when improvement is not noted or is not sustained. The outcome and the possibilities of treatment, both medical and surgical, are bound up in the character of lesion, degree of stenosis, and the possibility of its removal. The minor and medium grades of a benign nature are often most amenable to medical treatment; the severe forms require surgery in the beginning. Cancer is more of a surgical condition in its early stages than in the later ones. Pylorospasm, gastrophtosis, and small perigastric adhesions are essentially medical conditions. Marked cicatricial conditions after ulcer, hypertrophic gastritis with distinct retention, large foreign bodies or pedunculated growths within the organ, marked perigastric or omental bands from any cause, pancreatic cysts of large size, dermoids, and large benign extragastric deposits or movable spleen or kidney generally require surgery. The cases that are remanded for medical treatment should have constant attention, either for direct treatment or prophylaxis. In obstructive cases of a benign nature when not of severe degree the treatment should always be medical at the onset. Many of these cases become perfectly comfortable and satisfied with the results. In those in which this is not so, in whom relapses are frequent and the gastric symptoms are more or less continuous or the general health fails, surgery can quickly cure. Many surgeons believe that all pyloric stenoses of any degree are operable cases in the beginning, and some of the internists temporize with even the severe cases too long. It all depends upon the nature of the case and the results that can be obtained with treatment. There is no definite ground either way to suit all cases, for the simple reason that a diverse pathology runs through them. The matter rests upon the diagnosis of the pathological condition, the willingness and intelligence of the patient in following directions, the personal equation and judgment of the physician, and the value of service that he renders in the treatment.

**Treatment.**—The essentials of medical treatment are dietetic, general, and local. The dietetic treatment is essentially that mentioned under the early treatment of hyperchlorhydria and also that included under atonic ectasia, excepting that the foods must always be given in

the fluid, semifluid, or finely comminuted forms. Stagnation must be carefully guarded against, and those foods that give distress, ferment, or on aspiration are found to have remained in the stomach too long must be changed in form or discontinued. The best results are obtained by frequent small meals, about 6 in a day. Occasional lavage assists materially, and stretching the pylorus by the Einhorn apparatus may be tried in carefully selected cases. In a medium degree of stagnation when symptoms of distress come on acutely after the taking of improper foods, a quick vomiting, lavage, or ejection of the food by means of a stomach-tube would relieve the symptoms. When such attacks are frequent, surgery is indicated. Repose in the recumbent or left-sided position after meals is helpful. The bowels should be moved by enema. Medication to relieve the stenosis is useless, but olive-oil may be employed before meals and occasionally gives good results. When the medical treatment serves to little purpose, surgery is indicated, pyloroplasty, pylorectomy, partial gastrectomy, or gastro-enterostomy offering brilliant results in the non-malignant forms of stenosis of gastric origin and a few of the malignant ones.

#### **ACUTE POST-OPERATIVE DILATATION OF THE STOMACH AND DUODENUM.**

As has been mentioned, a mild degree of acute dilatation may occur as a result of indiscretion in diet or drinking, as a complication of the acute infectious diseases (pneumonia, typhoid, acute tuberculosis, scarlatina), as a sequel to continued disease of a debilitating nature, in head injuries and brain and spinal cord disease and any trauma, the idiopathic cases probably due to functional or toxic disturbances of an obscure nature, and the post-operative cases. The latter particularly are included in this chapter, and, since such are much more frequent than is generally supposed, and being a most fatal form, they are worthy of separate description.

**Etiology.**—The causation of this type of dilatation is still much of a matter of conjecture. The view most generally held is the hypothesis of Albrecht that a purely mechanical obstruction of the duodenum by the root of the mesentery and the superior mesenteric vessels occurs due to the sinking of the empty intestines into the true pelvis. Albrecht and other observers believe that this sinking of the small intestine is not sufficient to produce complete obstruction, but that it does produce enough obstruction to cause some degree of overfilling and distention of the stomach, and that this prevents the small intestine from returning to its physiological place in the abdomen, and thus a vicious circle is set up. In defense of this view are the facts

that conditions of prolapse (enteroptosis) accompanied by relaxation of the mesentery are commonly present in the cases, and the beneficial results that are obtained by the lavaging of the organ and the postural method of treatment.

Another view, directly opposed to the foregoing, is that a functional disturbance of the stomach is a primary feature in the process, and that the distention of the stomach, independent of any constriction of the duodenum, forces the small intestine into the pelvis and in that way causes the tension on the mesentery and the duodenal obstruction. In defense of this contention may be mentioned all of the toxic, traumatic, and disease factors which can cause this condition, the fact that even in enteroptosis a noticeable degree of mechanical obstruction is rarely met with, the fact that males and females are affected in like proportions, and the acute onset of the condition. While it is possible that in some cases the first-mentioned cause may be an initial factor, there is no doubt that a primary functional rather than a primary mechanical disturbance is the cause in the largest majority of cases. This latter view is held especially by Stieda, and von Herff, who says: "The more I study the condition the more I am convinced that acute paralysis and paresis of the stomach are caused by injuries to its nervous apparatus; that these injuries are probably in the nature of trauma to the spinal column; that in a certain number of cases they occur as the result of the toxic action of chloroform, or possibly ether or toxins formed in the stomach. For a certain number of cases there seems to be no satisfactory explanation as yet." Thoma also holds to these views. Kelling, on the other hand, thinks that a valve-like action of the cardia is the most important etiological factor in many cases, and seems to hold rather strongly to the mechanical explanation above offered as the correct one. The facts are that acute dilatation occurs frequently with narcosis, and that dilatations are exceedingly rare in operations, even severe ones, performed without chloroform or ether. It is, therefore, feasible that the general anesthetics themselves cause merely a motor insufficiency and thus may be looked upon as an additional or an exciting factor, the distention of the stomach with liquids, solids or gases, poor states of vitality, neurotic conditions, inflammations and prolapse also being necessary in the make-up of causes. Braun and Seidel<sup>1</sup> (who regard arterio-mesenteric obstruction as a secondary phenomenon) undertook a series of observations and experiments to clear the confusion in the etiology of this condition. They conclude that (1) acute dilatation of the stomach is an expression of and a result of acute gastric motor insufficiency; (2) this acute motor insufficiency can affect a stomach

previously healthy, as well as one the subject of a chronic or atrophic process; (3) it may occur as an independent disease or as a complication of other diseases; (4) the acute motor insufficiency of a previously healthy stomach is in the vast majority of cases of a purely functional and not a mechanical nature; (5) these functional disturbances are alterations of gastric innervation (central, peripheral, and reflex) and injuries to the gastric musculature; (6) all the surgical forms of acute dilatation may be explained on the basis of a disturbance of innervation, as well as most of those occurring in association with infectious diseases and with constitutional and other ailments; (7) a direct injury to the muscle fibers through mechanical, inflammatory or toxic lesions is possible, although gross histological changes have thus far not been observed; (8) motor insufficiency and consequent dilatation occur as the result of a damming back of ingested materials, decomposition processes, or abnormally increased secretion; (9) acute motor insufficiency may occur in the absence of a predisposing factor, in a healthy stomach with intact innervation, as the result of profound dietetic errors or abnormal decomposition of ingested material; (10) acute dilatations occurring on top of chronic dilatation are usually induced by mechanical factors; (11) primary acute pyloric or duodenal occlusion occurs but seldom, and can be diagnosticated only when evident anatomical or mechanical lesions are present; (12) arteromesenteric occlusion cannot be looked upon as the cause of acute dilatation, but only as a frequently unimportant result of the primary functional gastric dilatation; (13) the existence of a valve-like closure of the cardia has not been proved, and is not a necessary condition to acute dilatation of the stomach. In so far as the operative form is concerned it is important to remember that the condition can follow any type of operation upon any part of the body, about one-half of the cases following laparotomy. The latter fact has elicited much discussion upon the subject of traction on the duodenum, trauma from the handling of the abdominal viscera, large incisions, pressure upon the kidney, etc. as dangerous performances in operative procedure in the abdomen. It is only necessary to recall that operations upon this part of the body make up about one-half of the major surgical cases, and that these operations are usually severe and prolonged. In my opinion, the matter is more one due to the amount of anesthetic that has been given according to the general and local condition of the patient and to shock, and but very little to matters of surgical technique. The quicker the operation, the less the danger of post-operative dilatation. In addition to the effects of the anesthetic, I believe that a depressive nerve state, operative upon the musculature of the gastro-enteron and

due to the apprehension or fear of the operation, and added to this the operative shock, as mentioned above, have much to do with its development. Take the more common enteric and colonic post-operative distensions, which are mostly paretic or paralytic in nature, why is it that these are more common following operations upon the sane than insane and also on the highly organized and intelligent as compared with the more ordinary types of individuals? It has often occurred to me that this psychical or central cause has to do with the production of quite a number of these gastroduodenal cases also.

**Symptoms and Diagnosis.**—In a general way, three-fourths of all cases follow operations on patients between ten and forty years; the younger or older the patient, the less the danger. The time of operation and the amount of anesthesia being equal, no type of operative case is especially prone or exempt, males and females being about equally affected.

The definite gastric symptoms may be most acute and characteristic or may be absent. Naturally, the more severe the dilatation, the more sure it is these are present; still, markedly dilated stomachs in serious cases may exist without vomiting, pain, tenderness, thirst, or scanty urine, all of which are characteristic symptoms. The onset of the attack when severe is generally sudden. The patient survives an operation and the post-operative course appears normal for a few days or possibly as long as two weeks afterward. Suddenly, a distention of the stomach takes place, accompanied with profuse and persistent vomiting of large amounts of fluid; pain in the epigastric and umbilical regions, which may be steady or colicky; tenderness in the stomach region, and symptoms of collapse. Muscular rigidity is usually absent, arguing against a peritonitis. The abdomen swells, due to the enlargement of the stomach; the right hypochondrium becomes prominent and the left flattened, and the general gastric tympany on the upper left side shows an enlarged organ, the lower border being below the umbilicus, possibly extending almost to the pelvis. The transverse measurement of the organ is also increased, in some cases extending to the right mammillary line; epigastric tympany also is usually observed. On the passing of a stomach-tube to relieve the gaseous distention and lavaging to wash out the fluid, the size of the organ quickly diminishes. The stomach may be so distended with gas that the succussion sounds may not be distinguishable. Visible peristaltic waves may occur, but they are rare in the severe cases, being more common in the moderate grades that have existed untreated for several days. In such an event, following an operation or trauma, a stomach-tube should be passed at once, and the return from the stomach examined. It can then be seen

that an unaccountably large collection of fluid is present in the stomach, this at first being yellow, then yellowish green or green when regurgitation from the upper part of the small intestine is present, or final brown with solid particles and a fecal odor when the condition had existed for some hours.

A treacherous severe type may exist in which the characteristic symptoms are absent or are too slight and indistinct for definite diagnostic purpose. These are seen in the post-operative cases in which anorexia and gastric fermentation or intestinal flatulence have been present in a running way. Suddenly, for no assignable reason, a quick change is noted in the appearance and general condition of the patient. The countenance becomes dusky or pallid, the face appears "pinched"; the pulse more rapid, smaller and thready in character; the temperature drops and may even become subnormal; hands and feet cold, and the abdomen more or less distended. Such cases may not present much on examination of the abdomen, although the right upper aspect may be slightly prominent. In them the peristaltic sounds are more regularly present, but the pain may be very definite. As vomiting may not occur and stagnation of the stomach contents always exists, dependence must be placed upon the use of the stomach-tube for diagnosis, and fortunately this method of examination is usually conclusive, although its use in lavaging the stomach is not so often curative as in the first form. These cases are of the alarming fatal type, death usually occurring within a few days.

The most favorable cases are those of the milder types, in which the paralysis may be said to be incomplete. These comprise varying grades and are about evenly divided between the post-operative and mixed cases, such as occur in typhoid fever, pneumonia, etc. In these the onset may be slower and more indistinct, and the abdominal examination virtually negative. Noting the history of cause and remembering that the possibility of this condition in any degree always exists following operation, the diagnosis is suggested by a sudden unfavorable turn in the case during convalescence because of some obscure reason. In the mildest grades one or two vomiting spells that empty the stomach may change the appearance of the individual almost as quickly as was the onset of the unfavorable symptoms. The quick recognition of the condition and the early resort to the stomach-tube treatment save the majority of these individuals. In my opinion, in these slight cases the intestines may be mainly affected, and in this instance general gaseous distention and obstinate constipation are diagnostic features.

Particularly in the severe cases, the return from the stomach is free of hydrochloric acid, and lactic and other organic acids may or

may not be present, but bile is not an uncommon finding. In the less severe cases more or less hydrochloric acid and enzyme are found. The return generally contains more or less food particles, a rather large amount of fluid, and possibly blood.

Among the other symptoms that can be noted are: scanty urine, constipation, subnormal temperature, thirst, general muscular cramps,



Fig. 146.—Patient with author's continuous drainage stomach-tube in use.

tetany, hiccough and delirium. The diagnosis must particularly be made from peritonitis, intestinal obstruction and perforation.

**Prognosis.**—The prognosis in severe cases with typical symptoms is bad, about 70 per cent. of them dying in a short time. Every one of the cases that I have seen (7 in number) in which the gastric and abdominal symptoms were not much of a feature and the constitutional symptoms were quick and decided, terminated fatally in a few hours. The prognosis in all cases must be carefully guarded. The cessation of vomiting is not always a favorable sign; this may be due to the patient becoming so weakened and prostrated that vomiting is

no longer possible. More reliance should be placed upon the general condition of the patient, and the diminution in the amount and character of the return from the stomach obtained by the stomach-tube. When bile, steapsin and succus entericus and no gastric enzyme are constantly seen, the prognosis continues grave. When an achylie return slowly develops into one having hydrochloric acid and gastric enzyme, the prognosis becomes more favorable. Should there develop a fecal odor to the gastric contents or a return of fecal substance itself, the diagnosis must be changed to intestinal obstruction below the duodenum.

**Treatment.**—At once when the diagnosis of post-operative dilatation of the stomach and duodenum is made, all foods and fluids should be withheld by mouth and starvation with stimulation practised, and late on the rectal route of feeding utilized. In the severer cases with a sudden onset, early rectal feedings are not important, the enemas of infusion of coffee or other stimulants being first in order. In every case, both severe and mild, the stomach should immediately be evacuated, preferably by lavage with plain warm water, so as to relieve the pressure exerted by the organ, to clean out the fermenting contents and prevent them from further poisoning the body, and to act as a stimulant to contraction. The main reason for the use of plain water is that it answers all purposes and still leaves possible the examination of such stomach contents as are obtained. One must not wait until the symptoms appear marked, and in temporizing with emetics we can never be sure that the organ is empty. As Conner rightfully advises, the lavagings should be frequent, several in twenty-four hours, and in severe cases the distention and accumulation cannot be kept down unless this is done about every three hours. The severer the case, the more frequent the stomach washings, performing it once in every one or two hours not being too frequent in the beginning. The lavagings should be kept up for several days, according to the existing conditions. It is safer to lavage too often than not often enough. The author's method of continuous drainage of the stomach is a most useful and comfortable means to drain the stomach, medicate, and later on to feed the patient. This is found described on page 395. Thirst should be combated by protoclysis or hypodermoclysis. Rectal feedings should be kept up until the gastric condition has almost cleared. These cases die or get well quickly, and thus the rectal feeding for a few days answers all purposes. The bowels should be moved by enema (preferably saline solution), and hot turpentine stupes may be used to relieve the distention. The best purgative to employ is a single dose of elaterin in the form of trituration elaterini 0.03 ( $\frac{1}{2}$  grain) by mouth; calomel is too slow and not efficient, castor-oil is too slow and may give violent

gastric pains, the salines are too bulky and irritating to the stomach, and croton-oil is dangerous. Elaterin is a powerful and quick hydragogue cathartic, and early watery stools are beneficial to these toxic patients. Supported by strychnine injections, I have yet to see bad or depressing effects come from its use; on the contrary, I have reason to believe that it is a valuable drug in these cases. An efficient means to move the bowels and cause the discharge of gas is an enema of 30 grams (1 ounce) of pulverized alum in a pint of water. Atropine and strychnine should be given hypodermically; the atropine to relieve any possible pylorospasm and control secretion into the stomach, and the strychnine to benefit the paralysis and overcome the shock. The strychnine should be pushed in the beginning, giving about 0.003 ( $\frac{1}{20}$  grain) hypodermically every two or three hours, and its dose slowly decreased as improvement occurs. The giving of eserine is malpractice; cases in which it had been used have gotten better in spite of its use, not because of it. Strychnine is a far more efficient and safe drug to use to overcome the paresis. Lately a preparation called hormonal, an extract mainly of the spleen, has been used. I have employed it in 11 cases, not alone, but with other means, and all of them have recovered. In 2 of the late cases I used it, no benefit was derived. It is given in 15 cubic centimeter ( $\frac{1}{2}$  ounce) doses by deep injection into the gluteal muscles. Pituitary extract in 1-c.c. doses subcutaneously is distinctly the best form of medication, particularly when purgatives cannot be retained by mouth and there is much intestinal distension. The dose may be repeated in six or eight hours.

The next most important item of treatment is the postural method. There seems to be considerable difference of opinion as to which of the four positions serves to the best purpose. The half-sitting position and lying flat with the head of the bed blocked up have been advised for the type of dilatation which accompanies pneumonia when the cardiac and respiratory symptoms are marked. These postures relieve the pressure in the lower thorax and in that way relieve the embarrassment on the heart's action and the frequency of respirations. In the post-operative cases it seems logical to suppose that, while relieving the pressure on the diaphragm would serve to some purpose in so far as the chest is concerned and even favor downward drainage from the stomach, at the same time it would also increase the danger of a lower position of the small intestine and thus increase the element of mechanical obstruction upon the duodenum. For this latter reason the elevation of the foot end of the bed has been advised. Others have favored the side position, usually the right, to encourage drainage of the stomach, and some even, notably Schnitzler, have

employed the prone position (abdomen down). A combination of tight bandaging of the lower abdomen or the use of the Rose bandage together with the half-sitting position may serve to good purpose but as many of the patients have a laparotomy wound this bandaging is not practicable. Of late, I have been advising a combination of the two dorsal positions, and it seems to answer to good purpose. The procedure can easily be carried out by blocking up the head of the bed and placing a number of hard pillows under the thorax and head so as to keep these high. A couple of wide boards are next placed in the bed, one extremity resting over the elevated foot end and the other just under the buttocks. The patient is placed so that the back is bent in the lumbar region, whereby the thorax and head on one side and the hips and lower extremities on the other are elevated at the same time. This permits a fair degree of relief to chest embarrassment and also permits of a higher plane for the enteron. Not all patients can keep this position in comfort continuously, but those that complain the most vigorously are usually the ones that are getting well, and after that any of the other positions that give the most relief can be assumed.

At the subsidence of the symptoms feeding by mouth should be instituted. In the beginning only milk should be given and this only in small quantities and preferably peptonized. Later on, the quantity at each feeding can be increased (up to  $\frac{1}{2}$  glassful), followed by raw eggs in milk, bouillon, strained gruels, rice, farina, graduating up to the more solid foods. The dietetics during the convalescence of these patients must be carefully watched until complete recovery ensues, because fatal results have been reported consequent on the too early use of such foods as uncooked fruits, meats, etc. Operations have been performed for the purpose of draining or evacuating the stomach or relieving the duodenojejunal kink. These, in my belief, are unjustifiable procedures. The mild and moderate cases generally recover on the medical measures, and the severe cases do better without operation than with it. Furthermore, the severe cases are the most unsuitable for any form of operative procedure, and it must always be remembered that the condition came on from operation in the first instance and it is unwise to add a second to intensify it.

When the returns from the stomach show a changing from the stomach and duodenal secretions toward the contents of the lower bowel, we are not dealing with a paralytic ileus, but a definite intestinal obstruction. In post-operative gastrointestinal dilatations (ileus) the hollow viscera are paralyzed, and there is no motility, either peristaltic or anti-peristaltic. When fecal material is obtained from the stomach in these cases it is only after several days, is rarely definitely fecal, always small

in amounts, and due to accumulation that had taken place in the bowel from above. When after an operation, symptoms that appear to be those of ileus paralytica ensue, and the returns from the stomach show that fecal material is rapidly beginning to appear and intensify, we are not dealing with a post-operative gastrointestinal dilatation, but with an intestinal obstruction from some cause, and for this the indications are to operate at once, withhold food in the meantime, and keep the stomach lavaged so as to minimize the toxic factor.

#### CARDIOSPASM.

Under normal conditions there is a spasmodic contraction of the cardia by which both solids and fluids are momentarily delayed in their passage into the stomach. This spasm may be pronounced in certain neurotic conditions so that entrance of food is obstructed and the accumulation of ingesta in the gullet above the cardia causes a dilatation of the esophagus, either local just above the cardia (lower one-third of the esophagus), or general, as is seen in the long-standing pronounced cases. The anomaly can be purely functional in nature, when it is a manifestation of hysteria, neurasthenia, and marked anemia, or it may be secondary to certain diseased conditions of the cardia, lower gullet or stomach, as may be present in traumatic injuries from foods, ulcer, cancer, or the stomach conditions of an irritative type. No doubt many minor degrees of cardiospasm exist which are not diagnosed, either because the condition is transitory or incomplete, or because our attention is not directed to the condition. The symptom of slight difficulty or pains behind the lower part of the sternum on swallowing existing for a short time is quite a common history in many gastro-intestinal cases. The neurotic type, clinically, occurs in two forms: as a transitory paroxysmal affection lasting from a few hours to several days, and as the chronic form, which may extend over a number of years.

**Etiology.**—The affection has been attributed to the following causes: primary cardiospasm due to failure of the central inhibitory influence controlling contraction of the cardia (Mikulicz and Meltzer), primary atony of the muscular coats of the esophagus (Rosenheim), both a functional disturbance of the innervation of the esophagus causing cardiospasm with a concomitant weakness of the muscular wall brought on by paralysis of the vagus (Kraus), congenital disposition (Fleiner, Leuker, Luschka), primary esophagitis (Martin), and kinking at the hiatus cesophagi. In a considerable number of true cardiospasm cases I have been interested in the vast majority of them

having the strictured site at the base of the esophageal opening of the diaphragm, the strictured area rising and falling with the excursions of the diaphragm. Perhaps not more than one in ten have the spasm in the esophagus below the diaphragm, or at the cardia itself. The anatomy of the circular and third layer of muscular fibers at the lower esophagus suggests strongly that in spasm they would tend to open the canal rather than close it. The abdominal end of the gullet is funnel shaped.

The suggestion is strong that most cases of cardiospasm are due to spasm of the two inner divisions of the crura which surround the esophageal opening. I am distinctly of the belief that these sections of the crura are endowed with innervation that is bound up intimately with reflex transmissions from the lower chest as well as the upper abdominal. It is probable that in the average cardiospasm case the benefits from stretch-

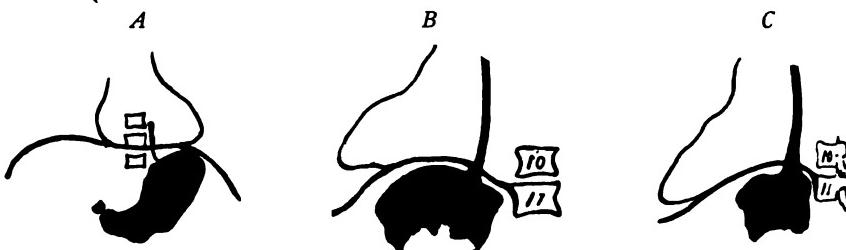


Fig. 147.—Normal esophagus at the lower end. *A*, antero-posterior view, showing the distance of the cardiac orifice of the stomach from the diaphragm, and the horizontal course of it between the two. *B*, is an oblique view, showing a slight funnel shape, and *C*, a view from side to side, showing a more marked funnel shape, this extending through the diaphragm in this individual.

ing are brought about by this being accomplished on the esophageal opening of the diaphragm, and not in the circular fibers of the gullet itself. Further proof of this contention is that on careful observation (X-ray) from side to side it can be observed that the stricture area is flat and that the fore part of the esophageal opening is drawn backward, in that way emptying on the front and dorso-lateral aspects of the tube at the site. Matter more fully explaining this may be found in an article by the author.<sup>2</sup>

Generally cardiospasm is the outcome of a hyperirritability of the vagus. Such are seen in the endocrinopathies; neurasthenics; reflexly from ulcer, carcinoma, gall-stones, kidney stones, left sided pleurisy, etc.; in toxic and metabolic conditions; and in local diseases of the esophagus such as acute esophagitis, fissure, ulcer, scar tissue formation, etc.

While it is probable that primary atony of the esophageal muscle can occur in rare instances, clinical observation and treatment of the

cases in which esophageal dilatation is present teach us that this is generally secondary to cardiospasm. As a rule, the cases give a history of cardiospasm over lengths of time and the dilatation occurs after that. This conclusion is further borne out by the evidences of early muscular hypertrophy in nearly all cases which have come to post mortem, and by the numerous cases of cardiospasm that exist unaccompanied by dilatation of the esophagus. Other than this, the different theories are largely speculative and based upon too few observations.

The condition occurs at any age, and is most frequently seen in females. Excitement is occasionally an important factor, and the



Fig. 148.—Anatomy of the crura about the esophageal opening of the diaphragm.

affection may occur after continued air swallowing. Neurasthenia, hysteria, anemia, the local disease, and the reflex causes make up the great majority of cases.

**Symptoms and Diagnosis.**—According to Plummer,<sup>3</sup> the development of cardiospasm may clinically be recognized in three stages: "1. In this stage the peristaltic contraction of the esophagus is sufficient to force the food through the spastic cardia. This is characterized clinically by the complaint of discomfort, pain, choking sensation, etc. 2. The peristaltic force of the esophageal muscle is no longer able to overcome the resistance of the contracted cardia, and the food is immediately regurgitated. This may result from an actual or relative increase in the obstruction at the cardia; that is, the spasm may become accentuated or the esophageal muscle may tire under

the usual load. In some cases the spasm is sufficiently severe from the onset to cause the immediate regurgitation of food. As a rule, the spasm is, during the early part of the history, periodic; but as the condition develops mild spasm becomes more continued or constant. Marked exacerbations in the spasm characterize the entire course of the disease. The increased work of forcing the food past the contracted cardia results in an early hypertrophy of the esophageal musculature. As the spasm increases in severity the esophagus becomes less and less able to overcome the obstruction, and atony and dilatation result. 3. Once the esophagus begins to give way the dilatation is rapid. This stage is characterized clinically by the retention of food in the esophagus and its regurgitation at irregular intervals after ingestion. If the spasm is mild for a sufficient length of time from the onset, the hypertrophy may become extreme and dilatation not take place or be delayed for years. The hypertrophy, after becoming well developed, may overcome a most marked resistance at the cardia. Relatively frequent severe spasm at the onset may lead to early dilatation before hypertrophy of the esophagus has time to develop. An impaired tone in the esophageal muscle at the onset of the trouble may also have something to do with the rapid early dilatation that takes place in some cases."

As a rule, the symptom-complex of cardiospasm is characteristic, although in the mild degrees of the acute form this is masked and only suggestive. In the majority of cases the spasm occurs suddenly and unexpectedly while eating. The attack is manifested by a burning, tightening and pressure sensation with indistinct pain behind the lower part of the sternum, the pain radiating to the back and neck. A dysphagia is present, due to the effort to force the foods into the stomach, accompanied by the sensation of the foods being arrested at some point. If this is continued, the accumulated food is regurgitated, causing at times some dyspnea, a relief of the symptoms of distress following the emptying of the gullet. The condition comes on periodically, and during the interval the patient is free from discomfort and able to swallow normally. In the more severe forms the acute attacks are more frequent and last longer at each seizure. Regurgitation and dyspnea are more prominent, and perhaps only fluid and semifluid foods can be ingested for some days. The final stage of a long-continued case is that of esophageal dilatation in which the acute symptoms on taking foods are absent or much modified, and those of regurgitation of accumulated food some time after ingestion prominent. In these, solid foods, like meat and vegetables, may be delayed at the cardia for several hours, the softer and fluid foods passing through in the meantime. At this time,

dysphagia is a noticeable feature and more or less constant, and continuous burning sensations from the irritation of decomposing foods in the esophagus are complained of. Such cases may regurgitate hundreds of centimeters of fluid several hours after a meal, usually during the night, when the recumbent posture has been assumed for a little time. Such returns contain no hydrochloric acid and gastric enzyme and the foods are in the form swallowed, these evidences pointing to the fact that the regurgitation is esophageal in origin, and not a true vomiting from the stomach. Even in the benign cases blood may be present, although this is more characteristic of malignant disease or ulceration. The second deglutition murmur is absent or much delayed, and the sign of Rewidzoff would not be present. Loss of weight is noticeable in the majority of cases, and in those of long standing in which esophageal dilatation exists, emaciation, invalidism and even death occur. The general effect on the body is altogether one of how much food can be completely swallowed to maintain nutrition. In some instances even the fluid foods cannot be taken in sufficient quantities, and in these the general condition is progressively downward. The X-ray method of examination is liable to lead one astray in these cases. It is plain to understand that a picture taken in the marked acute cases during the seizure, or in the more chronic cases during the interval, will show the sausage-shaped bismuth-food mass in the gullet (the lower pole being at the esophageal opening of the diaphragm) at one time and not at another. In the more marked cases the appearance may be that of an organic or malignant stricture, large diverticula or idiopathic dilatation or sacculation of the esophagus. These are discussed more in detail elsewhere.

The diagnosis is made on the obstruction to instruments (bougie or stomach-tube) in the esophagus in the effort to gain entrance into the stomach. The medium-sized olive should first be used, with which a resistance would be met at the cardia and which gives way under gentle pressure, the resistance gradually being obliterated on the passage to and fro of the olive through the cardiac orifice. A slight degree of resistance more easily obliterated may be noted with the smaller-sized olives, while the passage of the larger ones would be more difficult. In the normal adult, the largest-sized olive that is ordinarily supplied with the set of tips should pass a cardia with but little resistance. One may feel a resistance at one time when the symptoms are present, and at another time the same sized olive would pass freely. In the marked cases aspiration of the gullet above the cardia may give considerable return. A simple plan is to give a meal of soft, unstrained gruel (rice is best) in which about 20 drops of the ordinary 0.5 per cent. solution of

dimethylamidoazobenzol had been added, which does not change its color perceptibly or, if so, to only a faint yellow. In about fifteen minutes the stomach-tube is passed and aspiration performed at the point of resistance. If the gruel had reached the stomach a brilliant red color to the return is noted (changed by the free HCl), and if it remains white or yellow only the gullet had been aspirated (the organic acids that may be present in the stagnation of such a gullet do not affect the color of the reagent).

In organic and malignant strictures the stenosis is not easily overcome by the passage of the instruments; in fact, in most of the cases the stenosis becomes worse as time goes on. In differentiating the various conditions, the use of the esophagoscope becomes essential; in cardiospasm nothing locally would be noted, and when passed under an anesthetic resistance would not be observed, while in the organic and malignant diseases the strictures may be seen and the stenosis would remain permanent. Care must be taken, in cancer cases of the body of the stomach or pylorus, that these are not mistaken for those of only advanced cardiospasm. The main reason for this is that achylic and stagnant returns are commonly obtained from the stomach in cancer and secondary cardiospasm may be present. In uncomplicated cardiospasm the returns from the gullet are negative in reaction or show the presence of only small amounts of organic acids, the returns from the stomach showing hydrochloric acid. In cancer of the stomach without stenosis of the cardia, the Boas-Oppler bacilli may swarm in the lower gullet region; in fact, I may incidentally state that they often can be found in large numbers in the mouth and feces.

The main clinical features in cardiospasm are: the variability and remission of the symptoms, a delay or absence of the second swallowing sound when the spasm is occurring and its being normal in the remissions, a dysphagia during the attacks not present in the intervals, a resistance to the passing of esophageal instruments during the attacks not present in the intervals, and later on those of a more continuous obstruction at the cardia with esophageal dilatation, pressure within the chest, and oozing from the esophagus in the recumbent position.

**Prognosis.**—The outcome of all of these cases is good providing the condition is recognized and proper treatment instituted.

**Treatment.**—In the acute and periodical forms of a minor nature all that is necessary is to give attention to the nervous system and general nutrition of the body. The feeding should be high in caloric values and general in character, the irritating and bulky foods and drinks being eliminated. Baths, sufficient rest, regular exercise, abundant fresh air, proper routine of life, etc., should be insisted upon,

and the general tonics and reconstructive medications employed. Belladonna and the bromides should be used regularly when the spasms are severe and often, and the quantity should be pushed to tolerance in the beginning and maintained at a medium level afterward. The bowels should be moved by simple medical measures, and any form of gastro-intestinal disturbance properly treated. As strange as it may seem for spasm cases, nux vomica or strychnine is a useful drug to employ in all of the cases, particularly when esophageal dilatation exists. The weak galvanic or faradic currents of high frequency to the gullet are useful in the routine of treatment, and the electrical treatments should always be terminated by the outside electrode being held for some moments on the side of the neck over the pneumogastric, particularly the left.

Whenever we have any suspicion that the cardiospasm is of a reflex nature, be it, as cited in literature, from tonsils, middle-ear disease, or on account of an intra-abdominal condition, or worms, or if resulting from metabolic infections and toxic diseases, it should be treated accordingly. An attempt should be made to influence favorably the nervous system by hydrotherapeutic measures, change of climate and mental and physical rest. Psychotherapeutic measures and all other forms of suggestive treatment may have to be resorted to.

Very important is the mode of feeding. Early in the disease, and if we succeed in gaining the full confidence of the patient, it is often possible to have him partake of practically all kinds of food, thereby proving to him that there is no serious cause for the deglutition disturbance. This, however, is possible only in the minority of cases. In the great majority we must give the patient strict directions as to the kind of food, mode of taking it and the intervals at which it should be taken.

*Diet.*—The food should be of a non-irritating, semisolid and highly nourishing nature, and should include cream, plenty of butter, well-prepared cereals in milk, cream soups, fine vegetables (spinach, carrots, green peas, cauliflower) prepared in butter or cream, and soft-boiled eggs. Meat should be given scraped or minced, and bread in the form of toast or zwieback or biscuit, the patient allowing it to dissolve in the mouth before swallowing. The temperature of food and drinks should be neither too hot nor too cold.

When experiencing difficulty in getting food down, dry swallowing, as advised by Rosenheim, will often bring about an inhibition of the cardia and so allow the food to come down. It is best to give the patient small quantities of food at frequent intervals.

The length of time during which such a sparing diet is to be maintained must be judged according to the individual case. It should really

be carried out until the symptoms have disappeared and the confidence of the patient that he can take coarser food is established. Change from the sparing to the exercise diet should be gradual. For a long time we must interdict all spicy and irritating foods, liquors and even strong, effervescent drinks. We prohibit smoking, chewing and tobacco snuffing. In some cases pure olive oil in tablespoonful doses three times daily before meals serves as a soothing agent, and facilitates the passage of food.

*Medicinal.*—Vagotonia being in these cases the causative factor, atropin is a most useful drug. It should be given in doses of from 0.005 to 0.001 gram hypodermically, once, twice or three times daily until the full physiologic effect is produced. When the patient is even much improved, 0.5 milligram of atropin sulphate every second day can be given for at least one month. When subcutaneous treatment can for some reason not be carried out, extract of belladonna in the dose of from 0.015 to 0.03 gram in the form of suppositories is to be employed. Bromides, valerian and tonics such as arsenic, iron and anesthesin, may have to be used if warranted by indications.

When the stenosis is marked, mechanical measures to overcome the spasm are essential. The bougies can be used, the size of the olives gradually being increased to the largest. These should be passed regularly according to the exigencies of the case, and the olive should be held for some moments and drawn frequently through the cardia at each treatment. Various forms of dilating instruments have been advanced for the treatment of these cases, all of which are useful, particularly when the condition has existed for some time and hypertrophic stenosis of the cardia exists. Of these the Plummer dilating apparatus, which consists of a whalebone staff, with an olive drilled to permit a string being drawn through, and a dilator, is useful for the extreme cases. The process of introduction comprises the swallowing of about six yards of silk thread which passes down through a sufficient number of coils of the intestine to prevent its withdrawal on being pulled taut. The string is swallowed on two occasions, 3 yards in the afternoon and the remaining 3 yards in the following morning some time before the dilatation. The drilled olive is now passed down over the string on the same principle that a tunneled sound is passed over a filiform whalebone bougie through a deep urethral stricture. This insures the entrance through the cardia with the least amount of mechanical injury. A tube with a rubber and silk bag 22 millimeters in diameter is introduced over the whalebone staff and distended with water under sufficient pressure so as to make the stylet, tube and balloon form a solid sound. The sound is drawn up to locate the cardia, collapsed to draw it through into the esophagus and cardia, and then distended

again. In this way larger-sized bags can be used successively until no further resistance is met with at the cardia. The proper extent of pressure is when the large hand registers between 10 and 20. As only a few of the cases are so extreme that a single dilating instrument cannot

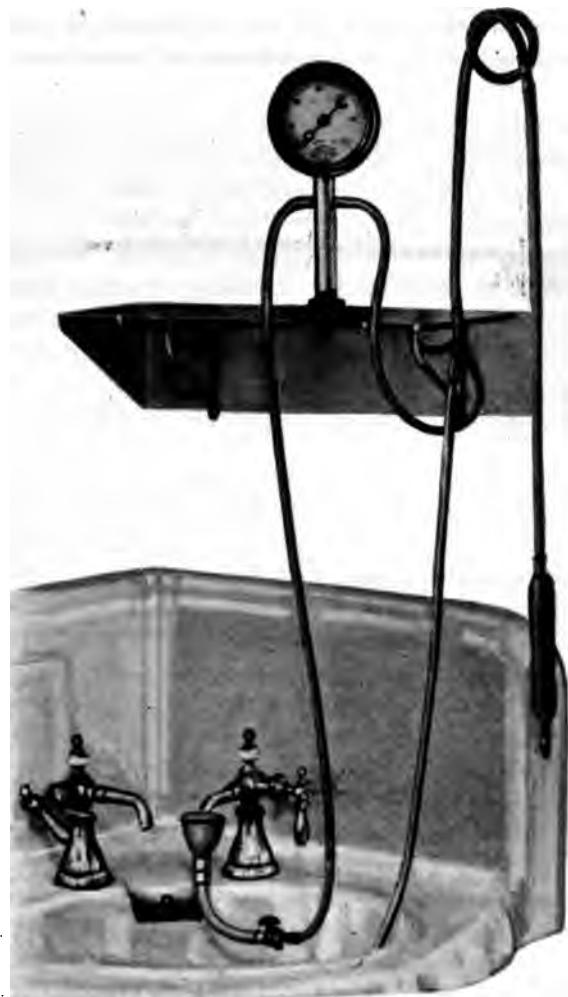


Fig. 149.—Plummer dilator, showing arrangement of tubing.

be applied directly (in marked cases the regular stomach-tube cannot be passed through the cardia without a dangerous degree of pressure), the other forms of dilators answer the purpose completely. Among these may be mentioned the Sippy dilator, which is introduced with a bougie, but

which is not very easily manipulated from below into the cardia, and the Einhorn instrument, which is a mechanical instrument having two parallels of steel at its lower end which are separated by a screw from above on the same principle as the urethrometer.

Einhorn<sup>4</sup> describes a method of retrograde stretching with the report of five cases in which a small balloon (on the end of a tubing) when in the stomach is inflated and drawn through the cardia from below. I have

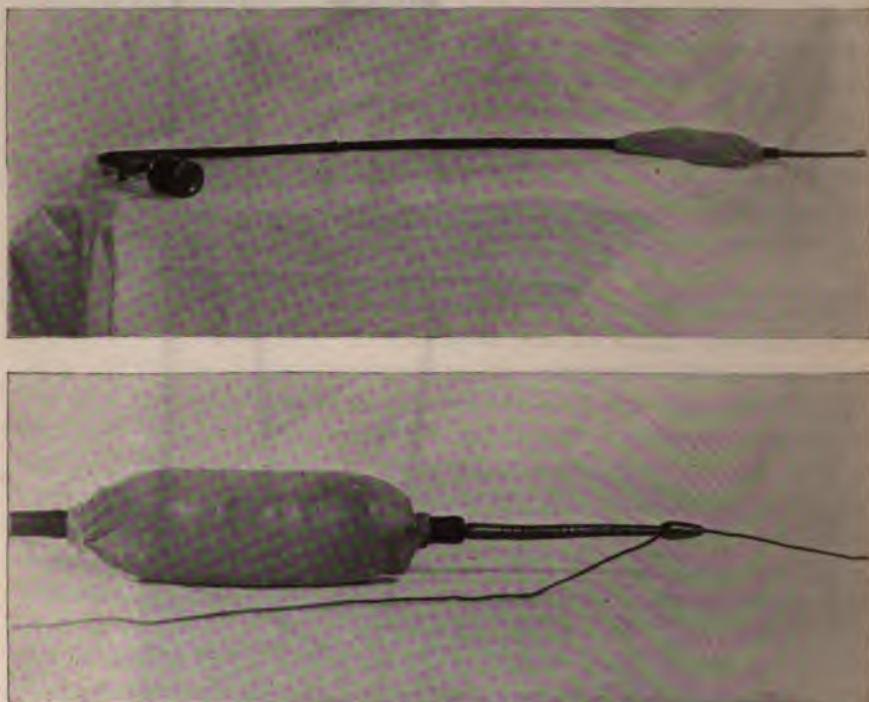


Fig. 150.—Author's cardio-dilator. Upper figure shows the entire instrument with the hand inflating pump to the left. Lower figure shows the lower end with the spiral feeler, its end olive threaded with a string (the bag had been inflated).

had no experience with it, preferring in all instances of cardiospasm an instrument which is threaded down on a string or filiform bougie which runs through the end of a "feeler." A stiff whalebone makes the instrument stiff and the bag at the lower end is distended by air which is always within control by the hand. I have used this instrument several hundred times without danger to the patient, having had one fatal case (and knowing of another) which were accomplished by the Plummer dilator. With the simple instrument I employ I have gotten through strictures which neither

of the Einhorn instruments could pass, and for seven steady years have had a uniform success with it.

A matter of interest in the cases that have been successfully stretched and which are running free from symptoms of dysphagia is, that whatever degree of dilatation existed in the esophagus before the operation, the dilatation persists. Whether it takes years for a gullet once definitely distended to get smaller, or it never goes back, is not possible to state. I have examined cases three years after the stretching and the dilatation still existed, no symptoms of it being present. This corresponds to dilatation of the intestine proximal to tight strictures, which when operated upon and the stricture removed, the dilatation persists.

Very intractable cases of cardiospasm may require operation for permanent relief. The cardia may be stretched by the fingers or some form of suitable instrument from the stomach side, a cardioplastic operation be done, or a division made of the crura or the esophageal opening of the diaphragm.

#### GASTROSPASM.

From a clinical standpoint, undoubted cases of gastrospasm exist, although the condition is usually associated with neurotic hypermotility, hypersecretion, or hypersensation. In the uncomplicated cases a marked neurosis bordering upon a neurasthenia is almost always present. The point in the clinical symptoms that should lead one to suspect the condition is the history of cramps in the stomach, with tightening sensations in the sternal region and chest, and indefinite painful sensations radiating across the upper abdomen and up the chest and back coming on a few moments after partaking of foods. Sometimes a regurgitation of fluids from the stomach is present, which tastes of the foods and is rarely acid, though perhaps only belching of gas exists. In a short time after the meals all of the symptoms subside, leaving perhaps a little distress, lasting an hour or two, the patient feeling most comfortable when the stomach is empty. The distinction between this condition and hypermotility and hypersensation can only be made by fluoroscopic examination, when it will be seen that, instead of the regular peristaltic waves being deep and active, giving the stomach an ampulous shape as is seen in hypermotility, or just the normal waves as seen in hypersecretion, the stomach goes through wild gyrations for the first few moments after food is taken, which gradually settles down in a movement like hypermotility for a while longer, or perhaps a normal motility. I have seen such stomachs contract down in the pyloric region to almost a transverse band extending from the pylorus to the costal margin, this contraction lasting for a moment or two; a general transverse relaxation takes place, showing the

normal width of the organ throughout, and then recurring again. In about five or ten minutes the cramps subside and the true peristaltic waves become prominent.

**Treatment.**—The treatment of the complicated cases is that of the most prominent condition, with a bland diet, such as has been advised for use in the hypersecretion cases; the sedative and anodyne measures (bromides, valerian, hot compresses to the epigastrium, and codeine and chloral in small doses some time before the meals), and attention to whatever local or general condition may be present. Along these lines the acute cases usually subside in a short time, but the longer standing ones are more resistant to treatment. Care should be taken that the patient had been long enough on a bland diet and had made improvement in a general way before the solid foods are allowed. When begun, these should be cut as fine as possible, mashed on the plate, free from stimulating condiments, and taken in small quantities. At that time meals every three or four hours until a normal motility has been definitely established is the best method, and it is wise to observe the patient by fluoroscope from time to time before three meals a day are allowed. When carefully handled and over sufficient lengths of time, the outcome of treatment is always good.

#### PYLOROSPASM.

Pylorospasm of only a neurotic nature is a rare affection occurring probably in not more than 0.1 per cent. of all stomach cases. It is much rarer than gastropasm or cardiospasm, and in by far the largest number of cases the condition is secondary or symptomatic of some other affection. The condition is usually due to some form of irritation causing a cramping or tonic contraction of the pyloric muscle, and is found more frequently in females than in males. As a neurosis it may occur at any age, but most often in early life. As a symptom of *bona fide* gastric (other than neurotic) and extragastric conditions pylorospasm is quite common.

**Etiology.**—An explanation of the cause of the neurotic cases has not been advanced, but several cases of nervous spasm have been described by surgeons in which at operation instances of non-pathological spasm were noted. In the largest number there exists such conditions as hyperesthesia, hyperacidity and hypersecretion, gastric and duodenal ulcer, gastrophtosis, gall-bladder disease, cancer at the pylorus, the reflex irritation from disease in other abdominal organs, etc.

**Symptoms and Diagnosis.**—At the height of digestion the pylorus suddenly becomes spasmodically contracted, the patient experiences an intense pain in the epigastrium radiating from the median line and

accompanied by eructations independent of food, nausea and perhaps vomiting and general symptoms of distress. In the majority of cases seen, a history of these attacks at intervals in the past is obtainable, the disorder appearing periodically at first, and finally becoming more continuous. Rather steady vomiting of stagnant foods then becomes a feature, and symptoms of hyperesthesia and hyperacidity may be present in the interval. The symptoms of gastric dilatations are then observed, and in long-standing cases a very atonic stomach may be present. The spasm may also come on during the night.

On examination during the attack, a sharply located tenderness corresponding to the pylorus is noted and perhaps a firm pylorus felt. The general abdomen may be retracted from spasm of the recti, and gastric tympany is usually pronounced. In the interval, a less distinctly localized tenderness in the region of the pylorus is commonly observed. The gastric analysis during the attack may show anacid, normal or hyperacid contents, depending upon the time that the onset of the cramp occurred and its degree. The gastric returns in the interval may be normal, or show a hyperacidity or hypersecretion depending upon the length of time that the condition existed, the extent of dilatation, the degree and type of neurotic disturbance, and the presence of the pathological factors that can produce pylorospasm reflexly. When the attacks are frequent and dilatation exists, stagnation of stomach contents occurs in degrees depending upon the associated conditions. The mixed meal method of examination may show gastric contents six, seven, or eight hours after ingestion. In these instances rapid emaciation, oliguria, severe constipation, increased thirst, and perhaps bulimia may be present. Conditions of tetany and chronic gastro-succorrhea may also be observed. The diagnosis is made by exclusion of the other functional, organic, and malignant diseases, and from these the spasmodic attacks of pain and appearance of intermittent stagnation are important. In the less severe cases the differential diagnosis lies between this condition and organic and malignant stenosis, primary atony, hyperesthesia gastrica and gastralgia, and states of hyperacidity and hypersecretion, etc.

**Prognosis.**—In pylorospasm the diagnosis of a neurotic cause should be made with hesitancy, because ulcerated states or results therefrom and other local and general conditions may exist and not give definite symptoms. The neurotic cases and those secondarily due to hyperesthesia, hyperacidity, and hypersecretion usually recover after a length of treatment devoted to these conditions. In the latter, however, relapses occasionally are met with. Even those reflexly due to other abdominal conditions than the stomach may be relieved by proper medical

treatment devoted to the pylorospasm, although in these the liability of recurrence is greater than in the neurotic cases.

**Treatment.**—When the treatment of some primary condition is successful and the case is well in hand, no special treatment is necessary excepting during an attack and shortly following it. During the attacks there is nothing to equal the results possible from a hypodermic injection of morphine and atropine. The diet should be bland and non-irritating and that suggested under hyperchlorhydria is the best in the beginning. The meals should be small, fluid and frequently repeated at regular intervals. Later on the semisolid and finely comminuted solid foods can be given. The regular administration of olive-oil is found to be of great service in all of these cases and this should be taken before foods are eaten. In gastrosuccorrhea belladonna forms an important item of treatment, and alkalies some time after meals are necessary in hyperchlorhydria. When the attacks are frequent and severe the bromides in large-sized doses are of benefit; a prescription answering to good purpose is the following:—

B Codeinæ sulphatis .....	0.13	gr. ij
Tincturæ belladonnæ .....	4.0	f3j
Strontii bromidi .....	60.0	5ij
Elixir. adjuvantis .....	250.0	f5vij

M. et sig.: Take a tablespoonful in a little water every four hours.

When the pain is not very severe, hot applications or a mustard plaster to the epigastrium may be sufficient without the morphine. Electricity in the form of intragastric galvanism is a valuable item of treatment and only a weak current should be employed; faradism is not so efficient in these cases, not even when atony exists. When stagnation is present constantly, lavage with quite warm alkaline or nitrate of soda solutions should be employed, but never with lukewarm or cold solutions. An underlying neurasthenia should be combated, and as long as this exists no promise of permanent relief should be made. If after faithful trial no relief or only slight relief is obtained, or a gastric ulcer or its sequel or a continuous hyperacidity or hypersecretion is believed to be present, exploratory operation should be advised. All of the persistent cases should be carefully examined not only for gastric or duodenal ulcer, but also for chronic appendicitis, and stones in the gall-bladder, pancreas, and kidneys. Pyloroplasty and pylorectomy are usually the surgical procedures of choice in the ulcer cases. Gastro-enterostomy, recommended by some authorities, has failed me on four occasions, the symptoms of pylorospasm in all returning inside of two years' time.

**REVERSED PERISTALSIS (ALSO THE SYNDROME TYPE).**

Digestion seems to suffer less distress from disturbances of secretion than from that of motility. Largely gastro-intestinal symptoms are motor in type, due to a speeding up of the current (hypermotility); a slowing (myasthenia, gastric, ileal and colonic stasis); stoppage (pyloric obstruction, intestinal obstruction); and reversal.

It may here be mentioned that the reversal types of motor disturbances have not received the attention due them. The reverse transport of material is a common happening in the tract; and while its severe manifestations, such as fecal vomiting, are generally known, its milder forms are passing unrecognized.

Vomiting from any cause existent outside of the gastro-intestinal tract, such as in pregnancy, is commonly initiated by increased tone and activity in the jejunum. It is well known that lesser shades of vomiting—namely, regurgitation—is a common finding in gastric disturbances both in the inherent and those due to duodenal ulcer, gall-bladder disease, chronic appendicitis and intestinal toxemias. With such slight disturbances of reverse peristalsis, heart-burn is commonly present, undoubtedly due to acidification of the fundic end of the stomach and lower end of the esophagus. It is probable, as Alvarez suggests, that belching is often due to reverse peristalsis, and that nausea, the precursor of vomiting, is due to the same cause. No doubt the initiation or stimulation of an onward peristalsis, from whatever cause, by means of a purge, is responsible for the relief of symptoms so commonly present in gastro-intestinal conditions when the bowels have been well opened.

In a syndrome makeup states of mild reverse peristalsis, Alvarez<sup>5</sup> presents with much good reasoning the following conclusions on some cases of vomiting, regurgitation, pyrosis, belching, nausea, coated tongue and foul breath, globus, fullness after taking of meals, and biliousness. "I believe that the underlying cause of all of them is a reversal of the currents in the tract. Thus, vomiting is often due to reverse peristalsis in the intestine; regurgitation is a mild form of vomiting; heartburn is due to the regurgitation of gastric juice into the upper esophagus; belching is closely akin to regurgitation; nausea is probably one of the ways in which we perceive reverse peristalsis; "biliousness" is the common name for the reverse peristalsis syndrome; a coated tongue and a foul breath are often the results of regurgitation; globus is due to reverse waves in the esophagus, and the feeling of fullness after taking a few mouthfuls is often due to back-pressure in the intestine.

"Those who may feel that I have appropriated nearly all of the gastro-intestinal symptoms for this syndrome are asked to remember that if, as seems likely, symptoms are produced almost entirely by disturbances in the motor functions, we should be most conscious of, and most annoyed by, the severest possible form of such disturbance, namely, a reversal of the current.

"The question may also be asked, If reverse peristalsis is so common why do we not see more of it with the Roentgen ray? Moreover, how can signs of reverse peristalsis appear from time to time during the progress of digestion, when food is actually going down the tract? First it must be remembered that most of the disturbances are due probably to ripples coming up the tract. Any oarsman knows that a wave will not carry his boat more than a few feet unless he is very near a sheltered beach. My records have shown that ripples can come down the intestine long distances without forwarding the contents, and can then break into strong waves which rush material along before them. I see no reason why similar ripples cannot travel upward in the wall of the bowel even though they show themselves as waves in the stomach and esophagus. When the gradient of forces in the tract is poor, waves can probably travel in either direction. When the stomach is full and active, it will be easier for waves to proceed aborally; when the stomach and small intestine are empty and the colon is full, the waves will more easily ascend. Moreover, animal experiments indicate that the gradient may not be upset to the same extent in all parts of the tract, so that, for instance, reverse waves might be present in the stomach, and normal ones in the bowel. Similarly, the heart that is beating with nodal rhythm sends the blood in the proper direction although the ventricles are contracting before the auricles. It is conceivable that ripples can ascend the digestive tract even when the gradient is not reversed. To explain what I mean, I will point to a case of a large river like the Missouri which undermines its banks in places until tons of earth tumble in. In the lower stretches of the river, where the current is not rapid, such a commotion might cause ripples to run a quarter of a mile uphill, and over water flowing in the opposite direction.

"Another reason why we cannot expect to see much reverse peristalsis with the Roentgen ray is that even normally we cannot follow the food in the small intestine after it leaves the duodenum, and before it reaches the terminal ileum. Actual reverse transport of material has been observed in those parts of the tract which are accessible to roentgenographic study. Twice I have seen definite reverse peristalsis in stomachs free from organic disease. Subsequent operation revealed the cause to be, in one, appendicitis, in the other, duodenal ulcer. More important than visible reverse waves are the reversed impulses that hold back the barium

here and there in the tract, in spite of the fact that the muscle is active, and the tube ahead is unobstructed. These are the conditions we see every day.

"Many physicians today are satisfied when they have appropriately labeled each case as a "gastritis," a "hyperacidity" or a "biliaryness." Their work then ends, as each label carries with it a certain string of prescriptions and, perhaps, a diet. I believe that this article will have been well worth writing if it helps at all in making men dissatisfied with some accepted ideas, and more inclined to think in terms of disturbed physiology. Such thinking must make for better therapeutics. The physician will more often seek for and find the lesion that is irritating the bowel and giving off the reverse waves. More often, also, will he see the hopelessness of medical "tinkering," and will call in the surgeon at once. If such radical treatment is inadvisable or impossible, he will use a smooth, cellulose-poor diet, which will flow more easily along the impaired gradient. He may, perhaps, be able to improve the gradient by resting and overfeeding the patient. Later, when the pharmacologist gets to thinking along these lines, he may find for us drugs which will restore the downward currents, either by increasing the activity of the upper part of the tract or by decreasing the activity of the lower parts."

#### HYPERMOTILITY NERVOSA.

While hypermotility as a symptom is commonly present in the irritated stomach, such as would accompany gastric ulcer, hyperesthesia, hyperacidity, or hypersecretion, there is no doubt that this condition can occur as a distinct neurosis of a permanent form in which such states as gastrospasm or pyloric disorders cannot be recognized as the clinical manifestation. It is possible that this condition may be a mild variety of the so-called peristaltic unrest of Kussmaul, but in it the characteristic peristaltic waves of the latter are not observed externally, the stomach can never be palpated and still the stomach empties quickly. The general use of the X-rays in the diagnosis of gastric affections often reveals some surprising conditions. The cases are not few in which a plate taken immediately after the ingestion of the bismuth-food mixture shows a large amount of the bismuth well advanced into the small intestine or spattered in irregular spots, shown all over the plate excepting at the sides, which correspond to the colon and lateral walls. It may be argued that such cases are only instances of pyloric incontinence, but every one of these stomachs (and I have observed many) can be inflated with air, which it retains about a normal length of time, and the examinations of the empty as well as the full stomach never dis-

play intestinal contents, bile, and pancreatic secretion in the organ. Furthermore, these cases preserve a relationship between the exit of the various forms of food, but with all forms the time of elimination from the stomach is much shortened. It is inconceivable to me that a pylorus could be relaxed so as to permit the stomach to empty within a few moments and not display a like result with all forms of food that ordinarily are taken, and also that a chronically relaxed pylorus would have the single action of only allowing passage from the stomach side and not permit more or less regurgitation through it from the small intestine. Compared with myasthenia gastrica of a neurotic nature in which distinct atony does not exist, hypermotility nervosa is found in the proportion of about 13 to 1 of cases seen. Strange as it may seem, hypermotility nervosa may coexist with the primary atonies in which the pylorus does not participate in the relaxation (as is often the case) and also in prolapse. This was proved to the author in several cases of long-standing primary atony in which, as a result of proper dieting and appropriate treatment, the digestive symptoms (usually intestinal) intensified as the stomach condition became better. I believe that there are two separate sets of nerves or nerves with selective functions, one presiding over the motility of the stomach and the other over the motility of the pylorus, and that in certain neurotic conditions the first could be affected and the second not so, although in other instances both may be at fault. To account for these cases it is probable, as Cannon's work has suggested to me, that the pyloric reflex or pyloric functioning power may be normal and still the gastric motor nerves be much stimulated or accelerated. The purest types are generally observed in well-nourished individuals, not commonly neurasthenic or neurotic in nature, in whom the symptoms are more of intestinal grouping.

**Symptoms and Diagnosis.**—Excepting the above-mentioned states in which functional hypermotility is observed and considering only the neurotic cases, the following may be presented. The condition is produced by dietetic influences, rather than general or central, and as a rule is found in those who habitually partake of large amounts of strong soups, coffee, and condiments. In my experience they are found mostly among the Germans and those who habitually partake of rich foods. The symptoms are subjective and those noted by gastric analyses and X-ray observations. Those described are: anorexia, flatulence and stomach distention after meals, hypersensitiveness to the richer forms of food and not so much to the simple or foods in small quantities, postprandial eructations, and looseness of the bowels accompanied with much gas formation in the intestine. In other cases only

anorexia is present with a disturbed sensation in the mouth and the intestinal symptoms predominate, the latter of which are only slightly or not at all relieved by a thorough purging. The return of a simple meal at the usual time shows a very small amount with a correspondingly low hydrochloric acid content, or, in fact, the stomach may be empty at the proper time of extraction and even in so short a time as fifteen minutes after an Ewald meal. Examination at forty-five-, thirty-, and fifteen-minute intervals shows corresponding gradations in quantity, the largest return being noted at the fifteen-minute interval. A carefully weighed out mixed meal shows a like result, excepting that the time for its elimination is about double that of the simple meal and the amount of meat content proportionately higher than the carbohydrate. The stomach is generally empty of the mixed meal in two or three hours' time. The morning stomach is always empty and no intestinal secretions are noted. Observation by the X-rays shows an increased peristaltic activity of the pylorus, body, and fundus of the organ, and the radiographs already described. The diagnosis must be made from the other conditions in which hypermotility is symptomatic, from pyloric incontinence, primary atony, other neurotic states of the gastro-enteron, and the benign intestinal or accessory organ conditions. In long-standing ulcer cases, in which hypermotility may have been present during its acute condition, a delay in the exit of foods generally exists.

**Prognosis.**—In all neurotic cases the prognosis for complete recovery is good, relapses not occurring if the necessary indications are observed.

**Treatment.**—In the neurotic form of hypermotility, the main indication of the diet is for the employment of solid foods. Fluid or semisolid substances may be taken in the midmeal interval, but overlapping with solid foods or too high caloric feedings should be guarded against. Of course, the foods should be cooked simply and free from condiments. The taking of soups, broths, tea, coffee, alcohol, and tobacco should be stopped, and in severe cases the assumption of the left lateral position after meals may be desirable. Lavage, douching, or electricity should never be employed, not even when a large flaccid stomach exists. The bromides in large doses or the regular use of codeine are the most efficient medications. In my experience, the acids usually increase the symptoms, *nux vomica* does not benefit them, and olive-oil taken before meals may be helpful for a short time, but should be stopped as soon as improvement sets in. The purgatives should not be used, and if constipation exists the use of simple enemata would be the means of combating it. Anemia should be treated by the use of ferruginous foods, already mentioned, or the non-astringent pharmaceutical forms of iron. The general hygienic measures or a sojourn in the

country are best to control an underlying neurosis, and if the symptoms of neurasthenia are present these should be combated in the usual ways. The diet, however, in caloric values must be held down for the first month or two, and after that only very gradually increased. The low degree of enteritis that is usually present in these cases passes off if the dietetic indications are observed.

#### REGURGITATION.

By regurgitation is meant that condition in which food is brought up in small quantities from the stomach into the mouth and ejected. This condition is the same as merycism, excepting that in the latter (rumination) the food is reswallowed. Mild degrees of regurgitation (eructations) are present in some of the cases of hyperchlorhydria, hypersecretion, and chronic gastritis, in which with the belching of gas or fluid more or less food is returned. There is a neurotic type, however, generally neurasthenic or hysterical in nature, in which a perfectly normal state of secretion and motility of the stomach are observed. The instances of this neurosis are not frequent, being found in not more than 3 per cent. of the cases of distinct gastric neuroses. They are more commonly found in adult males (in whom distinct neurasthenias are more common) in the proportion of about 5 to 1, the bulk of the cases being made up of the thin, poorly nourished, intellectual type of individuals.

**Symptoms and Diagnosis.**—As a rule, the onset is gradual, at first indistinct and finally becoming a marked feature. In the beginning the regurgitations can be suppressed, but when the habit is well established this may be impossible. The regurgitations may be periodical or chronic, becoming intensified after certain meals, and under deeper states of neurasthenia or general conditions. The history obtained is usually that of rapid eating, and states of chronic pharyngitis are commonly observed. When the condition is well established, the constant loss of foods and efforts in dieting for its relief cause emaciation and anemia. When the condition develops into merycism subnutrition is not so common.

The diagnosis is differentiated from vomiting in that nausea or definite emptying of the stomach or the suggestive conditions do not exist; from merycism in that the food is not swallowed again; and from eructations in that food is delivered into the mouth in large quantities instead of only gas or stomach fluids. The cases must also be diagnosed from those of esophageal or cardiac stenoses, and this is easily done on the history of the case, the noting of a patient's gullet with the instruments, and the examinations of the returned food for the stomach secretions.

**Prognosis.**—This is almost always good, and permanent relief is usually dependent upon the results obtained in the treatment of the neurasthenia. Some of the cases, which may be termed a chronic neurasthenia, or a neurotic temperament most susceptible to true neurasthenic additions, are difficult to treat and only get well after extended observations.

**Treatment.**—The general condition of the patient requires first attention, and then the neurasthenia and hysteria should receive appropriate treatment. The patient must be made to make efforts to suppress the regurgitations by voluntary control, and slow eating and thorough mastication should be insisted upon. At times when the spells are on, freedom from work and continued rest should be advised. In severe cases the rest cure with isolation may be necessary. Intragastric faradism is valuable in some cases. The best medications to employ are strychnine and the bromides, and a good combination is the following:

B. Strychninæ sulphatis .....	0.03 gr. ss
Sodii bromidi .....	20.0 3v
Elixir. phosphori .....	60.0 f3ij
Aquaæ .....	q. s. ad 250.0 f3vij

M. et sig.: Take a tablespoonful, followed by water, fifteen minutes after meals.

#### MERCYISM.

Merycism, "chewing the cud," or rumination, is that condition in which the foods are regurgitated into the mouth when they are again masticated and then either reswallowed or ejected. The condition is either a development of neurotic regurgitation or acquired by imitation. The first is seen chiefly in neurasthenia, and the second in hysteria. Several pathological and physiological explanations have been offered for the condition, and from its similarity to rumination in certain animals an hereditary explanation has been offered; but it is probable that the three above offered account for all cases seen. The cases in which heredity seems to play a rôle are probably explained along the lines of imitation, because the histories of family ruminants all show a direct descent and no instance of the condition in children during the first few years of life. The condition may develop as a result of sudden mental shock in a highly sensitive individual, and also is not uncommon among idiots and the insane.

**Symptoms and Diagnosis.**—The duration of merycism is very uncertain, varying from periodical attacks to a continuation during the whole of life. At first, it begins as a voluntary process in which a subjective sense of pleasure is experienced, and later it is involuntary. The regurgitation occurs when food had been taken and continues

for the time after a meal until the foods are unpleasant to the taste. As soon, however, as it becomes acid it is either swallowed quickly without mastication or ejected. Should an anacidity be present the rumination may be continuous during the day as long as there is food in the stomach, the condition not being present when the stomach contains only its own secretions or saliva. The diagnosis is made without difficulty, and can be confounded with nothing else excepting some cases of marked nervous regurgitations, from which it may be said that the distinction is not important. All degrees of gastric secretions have been reported, from anacidity to hyperacidity; so it is most probable that the state of gastric secretion is not important in its production. The prognosis is good if the patients are anxious to control the condition; not so if they are not. Relapses may occur after some mental strain or shock.

**Treatment.**—The most important item of treatment is for the patient to gain control of the habit, and further treatment than this is unnecessary in some patients. When this cannot be done, an absolutely fluid diet should be employed for a few weeks, following which slow eating and thorough mastication must be insisted upon. The alkalies should be used in hyperacidity, and the mineral acids in low or absent acidity. The eating of ice daily after meals has been recommended by Koerner. The taking of strychnine and quinine after meals is helpful, as they give an unpleasant taste to the foods, and also as good general tonics. The bromides and valerianates serve well in the routine of treatment. Intragastric electricity may be efficient in some of the cases. Lavage, douching, spraying, and gavage are not indicated. In neurasthenia and hysteria when the general state of health is poor, the hygienic, hydropathic, high-feeding, and psychotherapeutic treatments are necessary, but the patient should be kept under observation until the rumination is controlled; after that a sojourn in the country for several months would serve of value, particularly when some relative or friend is present who quickly expresses disgust when the symptom is noticed.

#### ERUCTATIO NERVOSA (AËROPHAGIA).

This condition occurs in periodic or paroxysmal attacks of noisy belching of odorless and tasteless gas. It is found in neurasthenia, hysteria, or as a result of a mental strain or shock. It is distinctive from states of fermentation or putrefaction in which eructations are present from the fact that in the latter the gases are generated in the stomach, while in the neurotic form the gas ejected is the returned air that had been swallowed (aërophagia). In my experience, the condition is not uncommon in atony or prolapse of the stomach, particu-

larly in young women. Linnosier believes that aērophagia is much like regurgitation, excepting that air instead of stomach contents is ejected. Ewald contends that the condition originates in the esophagus, beginning primarily by contraction of the muscles of the neck. It is probable that Oser's theory of air aspiration (during inspiration) into the esophagus and stomach explains the manner of air introduction, because in the instances I have observed distinct habits of air swallowing have always been denied and could not be proven in any of the cases. It is more common in females.

More or less air is swallowed with food, and there is no doubt that air is resident normally in the lower gullet and fundic end of the stomach. The greatest part of this passes out by eructation which becomes distinct when the intragastric pressure is raised (Kelling 25 centimeters of water). In aērophagia, however, the belching is esophageal and not gastric in origin—in the first it is voluntary and in the latter practically not so. In aērophagia the air is first gulped down and then expelled generally in loud explosions and in far too quick successions for its manufacture within the stomach.

**Symptoms and Diagnosis.**—The condition persists from a few hours to several days. When it is prolonged, intervals of relief are common, the condition coming on again when the patient's attention is drawn to the condition and when under mental strain or medical observation. Attention is attracted to the affection by the patient emitting a succession of loud eructative explosions rather regularly every few minutes, each manifestation perhaps being accompanied by a distressed expression in the face. The attacks are not present during sleep or when the patient's attention is engrossed by some outside matter. On examination nothing definite can be found excepting that the stomach may be very tympanitic. For this latter reason states of prolapse or atony can easily be noted on the first examination. The diagnosis is not difficult, although states of fermentation, such as accompany gastritis, malignant disease, and other conditions, must be eliminated. This is done by test-meal analysis and the X-rays.

**Treatment.**—The patient must make an effort to control the symptom. When this is difficult measures for treating the neurasthenia or hysteria are essential. In the long-standing cases the rest cure is required. Electricity to the gullet (faradism) sometimes answers to good purpose. The diet is indifferent, but should contain no stimulating foods or drink. In my experience large doses of bromides answer well to quickly control the symptoms, valerian serving best for a continued routine of treatment. When prolapse or atony of the stomach is present, it must be corrected by proper measures.

**SINGULTUS GASTRICA NERVOSA.**

Singultus, or hiccough, is a symptom expressed as a sound made by the sudden and involuntary contraction of the diaphragm, and the simultaneous contraction of the glottis which arrests the rising air in the trachea. Depending upon its cause, singultus may last for a few minutes or several hours or be continuous, and also it may recur during days and months. Among the numerous conditions in which it may be present may be mentioned: the diseases of the abdominal viscera (gastritis, primary and secondary ectatic gastric atony, gastric carcinoma); enteritis, internal and external intestinal obstruction or other causes of intestinal obstruction or paresis (such as the post-operative cases), appendicitis, and cholera; pancreatitis (usually suppurative); disease of the liver; peritonitis (especially when it involves the upper abdomen and the diaphragmatic peritoneum); and tympanites (such as the idiopathic dilatations or paretic conditions of the hollow viscera of the alimentary canal); the diseases of the nervous system—viz., epilepsy, tumor of the brain, meningitis, hydrocephalus, shock, mental emotions and hysteria; and certain constitutional conditions, such as diabetes, gout, chronic nephritis, some cases of gangrene of the lung, diaphragmatic pleurisy, dysmenorrhea and pregnancy, alcoholism, Addison's disease, typhoid fever and typhoid states, and large hemorrhages. The type of case I particularly wish to draw attention to here is a functional nervous form occurring with a hyperesthesia gastrica which is not hysterical in character.

Quoting a recent article of mine,<sup>6</sup> in which I drew attention to the existence of these cases, I again present the following: "Nervous vomiting, merycism, regurgitation, and eructations all pertain to a return of gastric contents as the main symptom. In singultus gastrica nervosa a continuous hiccoughing lasting over lengths of time varying from weeks to months and without any gastric return at any time may be seen. The condition usually accompanies a hyperesthesia of the stomach glandularis, likewise continuous while the hiccoughing is the feature. As a condition it is rarely met with (seen by me in only two cases of several thousand neurotic stomach conditions), and generally in well-nourished young adults, and most often in the female. When more of these cases have been studied it is probable that an argument will be presented that those of singultus nervosa gastrica are only those of hysteria in which a continuous hiccoughing is prominent. Against this I wish to argue that the close study of these two cases in the way of heredity, past history, cause, imitation, syphilis, hemorrhages, infectious diseases, chemical toxic causes (lead, alcohol, tobacco) and the usual symptoms

of hysteria were not present, and both of them had *bona fide* gastric hyperesthesia accompanying them. The most careful examination in both failed to elicit any skin anesthesia, hyperesthesia, or paresthesia; were mentally excitable or depressed and impulsive; had pain, emotional crises, loss of emotional control, spinal or vertebral pains, globus hystericus, vasomotor disturbances, disturbed sleep, somnambulism or cerebral automatism, paralysis, contractures, tremor, ataxia or choreic movements, absence of skin reflexes, complete loss of concentric limitation of the visual field, or disturbance of color sense; manifested the presence of hysterogenic zones, pseudo-angina, aryosthemia, constipation, and other of the less common clinical symptoms found more or less regular in the course of hysteria. Both of these cases were exhaustively examined by competent specialists, among whom were neurologists, ophthalmologists, gynecologists, and others, and both of them were considered normal in all other respects, and I therefore believe that such a neurotic condition of the stomach does occur, the cause of which is primarily situated in that organ, and that this gives rise to involuntary contractions of the diaphragm as a reflex manifestation.

CASE I.—Female, 29 years old; first came under observation in my clinic April 10, 1908. Her family history was negative, her father being alive and well, her mother dead from an unknown cause. She has several brothers and sisters, all of whom are well. No history of nervousness, epilepsy, alcoholism, etc., in the family. Her personal habits had always been good; she ate rather heavily of the substantial plain foods at regular mealtimes, drank nothing alcoholic, lived a happy and comfortable married life, and had no worry in particular excepting that she had not become pregnant, and this did not affect her much. Her bowels moved regularly once or twice a day.

At the time, she complained of gastric distress which had begun about four months before, and she had been under the care of two physicians. The symptoms she complained of were a burning distress in the stomach after meals (even those of the lightest kinds), accompanied with epigastric distention, a weight in the upper abdomen and a pressure in the lower sternum and chest. At these times some difficulty in breathing was present, occasionally headache, and a condition of nervousness from the distress at the time. At intervals, usually after eating much meat or a more abundant meal than usual, she claims to have had attacks of pain in the stomach (*gastralgie*), which necessitated her removing her corsets and perhaps going to bed. On two occasions a physician was summoned, hot applications to the epigastrium were applied, and in one an injection of morphine was given; these seizures ameliorated after three or four hours' time and the pains passed off in about two more (probably when the stomach was empty of foods).

Following a purge the night before, an Ewald test-meal was extracted, which showed a return of 70 cubic centimeters, which was normal in macroscopic and microscopic appearance, a total HCl of 60°, a total acidity of 65°, and nothing else worthy of note. Examinations of her stools and urine were negative, and her blood showed 4,470,000 reds, Hb. 89 per cent., 6900 whites, and the morphology of the reds and differential count of the white cells was considered normal. The

physical examination was negative, the woman was well nourished, her stomach was normal in shape, size and position, and nothing abnormal was noted in the abdomen, chest, mouth, etc.

On these findings the diagnosis of hyperesthesia gastrica with slight increased gastric secretion was made, and the case was treated with a work-down bland diet consisting essentially of milk, cream, butter, eggs and well-cooked cereals in amounts equal to 3000 calories per day, and small doses of bromide of soda and tincture of valerian. She reported at intervals of two or three days for about four months, during which time she made a rather slow but steady recovery. At the end of the sixth week another Ewald meal was extracted which showed a decrease in the hydrochloric secretion to about one-third of the former amount.

At the visit preceding her last to the clinic at this period she reported to have skipped a menstruation for the first time in years. On examination it was suspected that she was pregnant, and this was found to be the fact on a subsequent examination several weeks afterward. The medical treatments were discontinued and she was advised to take rather generally of all kinds of simple foods and report again after her delivery.

She reported again on June 12, 1909, and gave the following history. The child was born on March 5, living but a few moments after its birth. She says that during the first three months of her pregnancy she was troubled with attacks of vomiting and morning nausea, but that after this she had had no gastric distress to speak of and was only slightly constipated during the last two months of pregnancy. Two months before the infant was born, she began hiccoughing, at first at long intervals and then gradually becoming more frequent and pronounced. These seizures continued for three months following her labor, became most troublesome and incessant, and on the return of the former gastric symptoms she associated the two as part of the same condition and again sought aid.

The physical examination at this time by several specialists in the clinic and myself failed to show anything other than that she was about the same type of a case as before excepting that she was hiccoughing at intervals of about three minutes, the condition she said being decidedly less although not altogether ceasing during the night when asleep. A test-meal extracted a few days after her return and an X-ray plate showed practically a normal condition of stomach. On fluoroscopic examination distinct contractions of the diaphragm were observed at the time of hiccoughing.

In the beginning, the case was most troublesome to treat in that no measures seemed efficient to control or mitigate the diaphragmatic contractions. However, as a result of large doses of bromide of soda (10 grams per day), she gradually made improvement and at the end of five weeks of this treatment was hiccoughing only two or three times a day. The diet above mentioned was again instituted and persisted in, the doses of bromide lowered, and she finally made substantial recovery, although compared with her usual weight she was short 10 pounds.

"I believe this to be a case of the condition I draw attention to, the diaphragmatic contractions being a feature of the gastric neurosis, and in the beginning probably induced by the spasmodic contractions of the stomach and diaphragm—a condition common in pregnant women and the cause of the vomitings of the early months of pregnancy.

CASE II.—April 7, 1909. Mrs. E. B., 34 years old; housewife; mother of two children, the oldest 7 years, the youngest 3 years; family history negative; habits had always been good, ate regularly, lived a simple and happy home life, and drank very moderately of tea and coffee and nothing alcoholic.

*Personal History.*—Had always been moderately constipated, although when she drank four glasses of water and ate fruits twice a day her bowels moved without further assistance. She has had some minor attacks of stomach distress in the past years, usually in the late winter when she had been housed up too much. These attacks were on the order of slight degrees of distress in the epigastrium, lasting only a few days and passing off with a little care in the selection of foods she partook of and at which times she always had taken a purge. She began with "stomach trouble" in the first part of February of the present year. She awakened one morning with a frontal headache, became nauseated, and shortly vomited. Toward afternoon the headache subsided (took aspirin), the nausea became less prominent and she began to hiccup at intervals of about once every hour. On the following day she left her bed, the nausea was less pronounced, the vomiting had stopped but the hiccoughing continued. Gradually, there intensified a distress after the meals consisting of weight, depression, and distention in the epigastrium, eructations of inodorous and tasteless gases and a more noticeable constipation. Sometimes when the distress was marked there were pains radiating from the cardiac region to the left shoulder and back. At these times she felt weak and often was troubled with palpitation. From the onset of the acute attack the hiccoughing continued, becoming more frequent and regular. Fearing to intensify the always present distress in her stomach and particularly to augment the hiccoughing, she kept eliminating certain foods—even the simple ones—until she was living on only small amounts of milk before I saw her. However, no measures at dieting seemed to assist her, although under medical care of two physicians, the first of whom said she had "kidney trouble," the second "anemia" (the first attendant said that he did not find albumin or casts in her urine). She steadily ran down in weight until just before going to bed she was 27 pounds short of her usual weight.

On my first visit she was in bed, where she had been for five days, too weak to be about, and had not slept any to speak of in that time. Her emaciation and anemia were noticeable, her face drawn and anxious, hiccoughing without regurgitation about every four minutes, and tossing restlessly in the bed. She had an aversion for foods and drink of all kinds, had taken only small amounts at the earnest solicitation of her husband, and altogether looked desperately ill. On careful physical examination nothing particular was found excepting that her stomach was markedly tympanitic and the pyloric region reaching to 2 centimeters below the umbilicus; a hemic, cardiac and jugular murmur, and a regular pulse of rather small quality and a rate of from 105 to 120.

The laboratory findings of specimens obtained during the three days following were: Blood, red cells 3,100,000, Hb. 62 per cent., white cells 7750, differential count normal. Feces light colored, food particles normal, Gram differential stain not significant, no blood or mucus, 10 grams of feces in 25 cubic centimeters of water fermenting 23 per cent. of gas in twenty-four hours and inoculation showed 31 per cent. in the dextrose bouillon. Ewald meal, 79 cubic centimeters return, starch apparently well digested. Free HCl 21°, combined HCl 29° (total HCl 50°), total acidity 57°, enzymes normal quantity, no blood or increased amounts of mucus. Urine, 24 hours, 995 cubic centimeters; specific gravity 1021,

acid; no glucose, albumin, casts, nor indican; oxalic acid and uric acid in slight excess; chlorine and nitrogen content normal, sulphate content slightly raised, urea 11 grams.

The above-mentioned clinical condition ran on progressively for over three weeks. The day's consumption of food by mouth and retained on any one day was never more than 1500 calories, and 1000 more nearly represented the daily average. The hiccoughing was incessant day and night, and the acute distress caused by even small quantities of food or drink in the stomach showed that a high degree of hyperesthesia of the glandularis was present. Rectal feedings were resorted to and fortunately they were well borne.

Progress in the case was slow and discouraging. Bromides and chloral hydrate even in fairly large doses by mouth and rectum gave only slight if any relief of the hiccoughing, which apparently was the symptom of grave importance. Icebags, Priessnitz bandages and hot, moist applications to the epigastrium were unavailing, but some benefit was observed by the use of sinapis plasters to the epigastrium and back of the neck. Galvanism of the phrenics from the sides of the neck through the abdomen to the gluteal intervals was tried, but no benefit from its use could be noted. A partial chloroform anesthesia, not enough to deaden the sensibilities, was employed and during its administration the inhibition of the hiccoughing was invariably brought about—the regularity of the spasms recurring in the same intervals as before when the drug was discontinued. The picture of the case for the three weeks in bed was pitiful to observe; the woman became markedly emaciated and the pulse fast and faint and it looked as if a fatal issue was inevitable. For no therapeutic measure that I can definitely ascribe to it other than the length of treatment, the hiccoughing began to lessen in frequency, the stomach became more tolerant, more nourishment could be sustained, and the general condition gradually improved (at the time she was being given hypodermically moderate doses of strychnine nitrate, gr.  $\frac{1}{50}$ , every four hours, for its general stimulating and tonic effects). Three weeks after the beneficial change took place (altogether nearly six weeks), she left her bed still very weak and hiccoughing about once every hour and the seizures were not so audible and probably the spasm not so severe as before. In about four weeks longer, the hiccoughing had stopped and the woman then made a rather quick recovery. Eight days after her first day out of bed she was weighed and it was noted that she had lost 49 pounds in weight, weighing at the time 91 pounds. She was weighed in my office on September 15, 1909, when apparently well and was about 6 pounds short of her regular weight. However, she still had some sensory distress in the stomach but no hiccoughing.

"This case was like the first described excepting much severer in degree. It proved to me that the condition may be seen as a serious type of affection, and in certain instances may even terminate fatally.

"Finally, I wish to state that true cases of hysteria in which hiccoughing is a feature are not uncommon and are decidedly more numerous than these I describe. But in them more or less prominent manifestations of hysteria and the appearance of the case are always significant. In these the diagnosis is not difficult, and this makes the differential diagnosis between the two easy. Where doubt may exist, the rather unimportant feature of local and persistent gastric symptoms,

together with the fact that hiccoughing hysterics (even when this symptom has existed for a long time) do not show much if any general deterioration in health, would be helpful in distinguishing them."

#### VOMITUS NERVOSUS.

Nervous vomiting may occur as a direct or reflex neurosis affecting the vomiting center in the vagus nucleus in the medulla, or may be reflex, affecting the stomach, diaphragm, esophagus and pharynx. Excepting the forms of infectious, organic or malignant disease in which vomiting as a symptom is present, the neurotic type is not an uncommon affection. In these cases it is characteristic that the vomiting is persistent, independent of the quantity and quality of foods, in its close association with states of the general body and neural system, and its appearance dependent upon meals. The cases are more frequent in females and, altogether, nervous vomiting comprises about 3 per cent. of the gastric neuroses. The forms of neurotic vomiting have been described in three main divisions: (1) Cerebrospinal or central, such as occurs in meningitis, encephalitis, apoplexy, abscess, cerebral tumors, in brain anemia and hyperemia, concussion, intoxication (ether, tobacco, etc.), autointoxications (constipation, indicanuria), septicemia, and in the spinal cord conditions of locomotor ataxia and transverse myelitis. (2) Nervous vomiting as a functional neurotic affection such as is seen in the poorly nourished, anemic sufferers from mental or physical strain, and neurasthenia and hysteria. (3) Reflex vomiting accompanying various affections of the stomach, eye, pharynx, larynx, middle ear, lungs, intestines, liver, gall-bladder, kidneys, male and female generative organs.

**Symptoms and Diagnosis.**—The instances of so-called idiopathic vomiting (vomitus nervosus) are further divided into (1) psychical vomiting, caused by some form of fright, shock, or sudden mishap; (2) juvenile vomiting, occurring in school-children from overwork; (3) juvenile periodic vomiting, a peculiar form occurring in the infant and which condition generally passes off after the third year; (4) periodic vomiting of the adult (von Leyden) characterized by vomiting spells occurring at regular intervals for an unknown reason, the attacks lasting from a few hours to several days and preceded by nausea, gastralgic pain and headache, the patient being apparently well in the interval; and (5) the single attack and persistent nervous form in the adults (mostly females), obscure in cause or due to plainly evident general conditions. The diagnosis is made from the history, character of the vomiting spells, the exclusion of all other causes of vomiting,

and a normal test-meal analysis. The various forms of idiopathic vomiting may so merge that separation into one or the other of the mentioned clinical types is impossible.

The distinguishing features of the vomiting are the ease with which it takes place, the fact that the vomiting is independent of the quality and quantities of food, and the absence of nausea. Sometimes when both solids and fluids have been taken only the fluids are ejected. When the condition has been established for some time, the patients lose in weight and physical strength, become more nervous, and the anemia may be marked. As a rule, the vomiting spell is quickly over, a few moments after which the patient may again partake of foods which remain in the stomach. In marked cases the skin becomes dry and the urine scant from the constant loss of fluids from the body. In the periodical form the patient is distressedly ill, and, the vomiting continuing, mucus and bile return may be the terminal ejecta. In these cases a degree of abdominal pain may be complained of, and there may be considerable vertigo, the pulse weak, the constipation marked, and the secretion of urine almost absent for the time being. In several of these cases I have made X-ray observations of the stomach and gullet during the course of the vomiting to learn the physiology of the act, these being suitable cases for this procedure. I have observed that the process of vomiting begins with a regurgitation from the stomach into the lower part of the esophagus. This the stomach continues until a considerable amount has been sent into the esophagus, when antiperistaltic waves begin forcing it upward through its upper position and into the mouth. In vomiting, the contractions of the abdominal muscles only force the contents of the stomach into the lower esophagus; its propulsion into the mouth is due to antiperistalsis of the esophagus.

The diagnosis is made from the history, character of the vomiting, the noting of general neurotic symptoms of a functional nature, the absence of any positive findings in gastric analyses, the observation of conditions in other organs that may reflexly cause the vomiting, the unsatisfactory results obtained from the usual remedies employed to check ordinary vomiting and the almost magical results from bromides, valerian, and hygienic measures. The diagnosis must be made from all affections in which vomiting is a symptom, and, while in the beginning this may be somewhat difficult, the nervous origin of this form soon becomes apparent.

**Treatment.**—Not considering the juvenile cases, the treatment may be divided into those for each of the clinical forms. With all, however, the chief aim is to remove the cause and to give such advice as would build up the general tone of the body. The psychical form

only requires a brief employment of sedative treatment for the vomiting, because the condition quickly corrects itself.

In periodical and reflex vomiting absolute rest should be secured. To these ends, quick relief of the symptoms is best accomplished by a single hypodermic injection of morphine or the use of a few opium suppositories. A mustard plaster to the epigastrium and cold applications to the head often are efficient in controlling the vomiting, and when this persists, the mouth or, better, the rectal administration of bromides and possibly also chloral hydrate in solution are effective. The swallowing of pieces of ice over which a little brandy has been poured offers some relief. It is best not to use the ordinary coal-tar preparations, although aspirin is often of service in relieving the general symptoms of distress. On recovery, the patient should be examined for the cause of the manifestation and treated, and in the absence of these a sojourn in the country and hydropathic procedures would prove of value. There is nothing particular concerning the diet, excepting that when the symptoms are intense foods should be withheld for a few hours, and in the interval high caloric feedings should be maintained.

In the persistent form (idiopathic vomiting) the routine of treatment is somewhat different. These cases may be divided into those that succeed on ambulatory treatment, and those that do not or are the very long continued or extreme types. The history as to mode of life and other details of like nature must receive attention and advice be given to correct or minimize them as much as possible. Special treatments for the vomiting *per se* usually are not successful. Change of scene may be necessary, and the avoidance of mental excitement, worry, anxiety, suspense, late hours, trying work, etc., must be controlled. No regard should be paid to the vomiting, and the patient should be told that the symptom is not important or serious, and should always make direct effort to control its occurrence. Special dieting serves no distinct purpose, excepting that frequent small meals may be advisable. Sometimes the solids are retained better, sometimes the fluids. The most efficient drugs are the bromides and valerian, and these should be taken regularly in large doses. Concerning them it may be said that even when employing large doses it may take a week to control the vomiting. After this event the doses should be reduced, but still continued over some weeks of time. The hydrotherapeutic treatments are of benefit, and electricity may be of psychical value. In the more extreme cases the institution of the rest cure may be essential for recovery. Feeding by gavage for a period may be helpful, during which time self-feeding should not be allowed. Faradism is a more efficient procedure in

the bed-ridden cases than in the ambulatory. After the bromides, the special or general tonics should always be given for a length of time. A change of occupation for the patient often answers to a good purpose.

#### PNEUMATOSIS.

Under the above term are classified a group of cases in which the stomach is distended with air, the expulsion of which seems impossible. Many of these cases correspond to the so-called asthma dyspepticum of Henoch, and may be conditions of aërophagia excepting that the air is not regurgitated as in eructatio nervosa. Other instances are seen in cardiospasm, pylorospasm, atony, dilatation, prolapse, neurotic temperament, neurasthenia and hysteria. It occurs as a periodical or continuous condition, brought on or intensified by mental strain or disorders of the general system. The condition is more common in males, and is generally seen in individuals of the intellectual type.

**Symptoms and Diagnosis.**—In typical cases the epigastric and gastric regions are found greatly protuberant, the upper abdomen may be balloon-shaped, and the organ tensely tympanitic. When these are marked the patient experiences a constant effort to belch without result, a sensation of distention in the abdomen, a difficulty in breathing and a tightening sensation in the thorax, great anxiety from the distress, and perhaps collapse with rapid and irregular pulse and cyanosis. In the continuous form the distention is not so marked, may be mostly fundic, and the symptoms of dyspnea be less distinct. The gastric analysis is indifferent; it may be normal, or of high or low acidity. A continuous case that was under my observation showed the variability of gastric secretion described in neurasthenia gastrica.

The diagnosis is made from the history and the exclusion of other stomach conditions in which distention is common, and from angina pectoris and other cardiac affections.

**Treatment.**—In the acute cases the most efficient procedure is the quick passage of the stomach-tube to relieve the distention and to note the patency of the cardia. In this the symptoms of dyspnea, etc., disappear at once, but the passage of the tube may have to be repeated at intervals to preserve comfort. In the continued cases the stomach-tube may not be necessary. If a tube is not at hand, the attack may be relieved by a hypodermic injection of morphine (Ewald): an efficient procedure even after a tube had been used. Ten drops of Hoffman's anodyne, spirit of peppermint, or chloroform spirit

ater, or 5 drops of turpentine on a lump of sugar, may by causing belching. The routine of treatment underlying neurosis, neurasthenia, or hysteria, for that strychnine or nux vomica should be indicated have been recommended in the recurrence of attacks, but these are, and the valerianates.

#### TRIC PROTRUSION.

because of its rarity, it not having been case, and the simplicity in making a diagnosis is the only one I have seen, and it seemed that the condition was an abdominal wall-diaphragm elongated into a form of motor neurosis.

July 27, 1911. Occupation, high-school pupil during the day, in a drug store in the evening. Aged 17. Family history: Father healthy, mother well, two brothers and three sisters all well. Previous had measles as a child, several attacks of simple catarrhal colds; otherwise. Habits good, excepting that he ate rather heavily.

*Present History.*—Beginning in childhood, he contracted his abdomen from time to time as a boyish prank. At first the bulging of the epigastrium was rather difficult to bring about, it taking much longer than at present and not always accomplishing it when he wanted to. Of late years he could do this much easier, exhibited it to his friends until he became considerably talked about in his town, and now, although he could always bring the condition on when he wanted to, it occurred from time to time involuntarily (even when he made a deliberate effort to control it); so that each day he would have a number of seizures. Two years ago began suffering with headaches, constipation, and considerable belching of gas following the meals, coming on at once or within the first fifteen minutes afterward. During this time he had more or less post-prandial distress in the stomach, particularly when he partook heavily of sweets. Has a polyphagia, sleeps well, and has gained considerably in weight during the last year.

*Examination.*—Well-nourished boy of good muscular development. Heart, lungs, urine, blood, etc., normal. Marked gastric splash; organ somewhat relaxed, but not enlarged or puffed. Left lobe of the liver plainly palpable and margin low, although the right lobe could not be felt and upper border was in normal position. In repose and viewing the upper abdomen from the side, there was a transverse fullness in the epigastric region which seemed to be due to the prominence of the left lobe of the liver and a general tissue growth.

During the examination a contraction came on. It began with a slight inspiration and a fixing of the abdomen in that position, followed by a contraction of the abdominal muscles below the transverse navel line without any noticeable bulging of the epigastrium. He then seemed to fix the lower abdominal muscles, slightly exhaled, and took an inspiration, at which the descended diaphragm, working against the contracted abdomen below and an accompanying relaxation of the abdominal muscles above the transverse navel line, caused the liver (left lobe)

and a portion of the stomach to extend forward and make up the protrusion. The prominence of the liver when the abdomen was in repose was due to a twisting forward of the organ, which had become set that way from the constant malformation during the seizures. The treatment advised was a cessation of the habit,

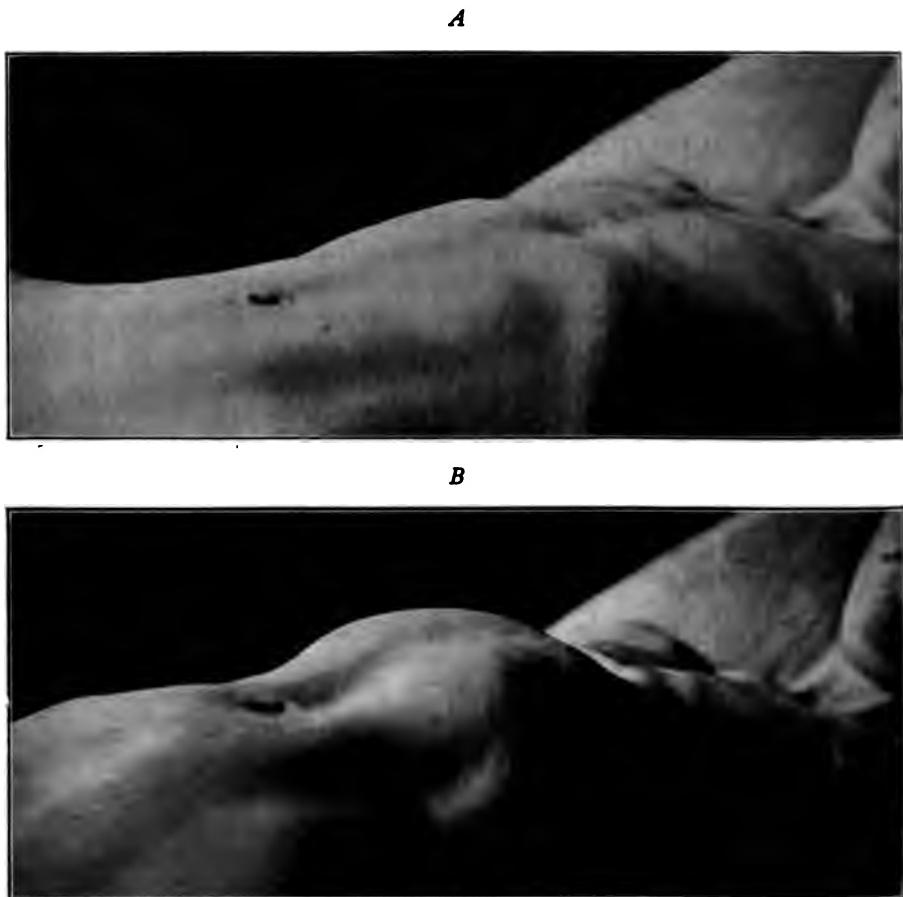


Fig. 151.

*A*, Patient under ordinary conditions. *B*, Appearance of upper abdomen during the spasmodic seizure.

an anti-constipation diet, 5 drops of tincture of nux vomica three times a day to correct the slight degree of gastric atony, and general hygienic measures.

#### PERISTALTIC UNREST.

This condition was first described by Kussmaul as occurring in neurasthenic individuals, in whom excessive peristalsis caused annoying cramp-like sensations and visible contractions of the stomach.

While visible peristaltic movements are most generally seen in obstruction of the pylorus, a neurotic form not due to stenosis may occur. The condition usually accompanies neurasthenia and hysteria and is an exceedingly rare affection. Cases have been described by Schütz, Cohn and others in which antiperistaltic movements have been noted. The affection occurs more commonly in men and in those who are in middle life.

**Symptoms and Diagnosis.**—The most important symptom is the noting of violent visible movements of the stomach in an organ in which pyloric obstruction does not exist. These waves run downward from the costal margin toward the median line, and in the four neurotic cases I have observed it occurred to me that they had a higher and more active wave than is ordinarily seen in pyloric obstruction, in which condition they are seen about six in number to the minute. This visible peristalsis is often accompanied by like movements in the intestine (the latter of which, however, are not so plainly visible as those of the stomach), more or less loud rumbling, which through a thin abdomen may be audible at a distance, and crampy sensations that are felt by the patient. Examination of the case may show a stomach which empties itself too quickly or normally, and fluoroscopic observations with bismuth plainly show the wild gyrations of the organ. With these, subjective symptoms are often present, prominent among which may be mentioned eructations, nausea, anorexia, sinking sensations in the stomach, constipation or diarrhea, and also those of neurasthenia (depression, lassitude, loss of energy and the vasomotor disturbances). Examination with the test-meals may show any degree of stomach secretion at the time, but more or less variation (as is described in neurasthenia gastrica) in later examinations. In making a diagnosis, stenosis of the pylorus, above all, must be excluded, and this is easily done by examination with the stomach-tube, the X-rays, and the observation of the case. The clinical distinction between it and gastrospasm is not important; in gastrospasm the history is more suggestive, and visible peristalsis is not discernible excepting by X-ray.

**Treatment.**—If a marked or moderate degree of true pyloric stenosis is believed to be present the case is an operable one. If not, treatment directed to the neurasthenia must be instituted according to the degrees of this condition. Extensive outdoor exercise serves a good purpose in the moderate cases, this being portioned off into certain definite times during the day. Retiring early and hydrotherapeutic treatments are also efficient. Occasionally, intragastric faradism or stomach lavage with rather cool water answers well in the routine. The diet should be bland,

yet abundant in variety, and small meals at regular intervals are best. General tonics or hematinics in the anemic should be given in all cases. The stomach symptoms are best controlled with the use of large doses of bromides and valerian, and these should be given an hour or so before meals, and the tonics after. Belladonna and codeine may also be employed in selected cases. The bowels must be kept well open, preferably by the use of simple or laxative measures.

#### ANTIPERISTALTIC RESTLESSNESS.

Cases of this condition, which probably are identical with peristaltic unrest, have been described by Glax, Schütz and others in which the waves pass from right to left. Cannon has found antiperistalsis to be an important motor phenomenon of the large intestine, and the author has noted it in the esophagus in the process of vomiting. From his observations it seems reasonable to suppose that, under ordinary conditions after the intestinal contents empty from the ileum through the ileocecal valve into the head of the colon, from which they are carried onward for some distance, certain antiperistaltic waves in the colon then carry a portion of the food back toward the valve, establishing a sort of circulation in the ascending colon. This function of the large intestine probably has to do with the final resorption of food elements into the portal system. From time to time, proper peristaltic contractions move the contents onward toward the lower colon and rectum, where the residue collects as feces. In cases of antiperistaltic restlessness of neurotic origin it is assumed that the movements originate in the intestine, passing upward to the stomach. In neurotic cases, when the abdominal walls are thin enough, it is not unusual to observe quite vigorous peristaltic movements in the intestine, passing in various directions, but not existent in the stomach. Cases of antiperistaltic restlessness must be differentiated from pyloric or intestinal stenosis and conditions of abdominal prolapse. Small antiperistaltic waves seen by X-ray running from the pyloric region toward the fundus are indicative of pyloric obstruction from some cause. The treatment outlined in peristaltic unrest also answers for these cases.

#### PYLORIC INCONTINENCE.

Attention was first called to incontinence or insufficiency of the pylorus by de Séré. The pylorus may be incompetent in unyielding pyloric neoplasms, or from traction of internal scars or external adhesions. The condition may be due to chronic gastritis, particularly of the atonic types, and it is not uncommon to find a deficient com-

pensatory activity of the pyloric muscle in such as accompany continued fever or chronic wasting diseases. It is also probable that the pylorus becomes relaxed in acute intestinal stenosis from any cause, and in cases of excessive vomiting. A neurotic type of affection has been described in which an incontinent pylorus fails to prevent the chyme from emptying into the intestine at a too rapid rate. Much has been written on the frequency of this simple or neurotic type, yet there is no doubt that it is an exceedingly rare affection. My experience has been, even in extreme grades of primary atony in which one would suppose that the pylorus would also be relaxed, that it is only very seldom so. While there seems to be considerable doubt as to the probability of this condition, there is some reason to believe that it can occur. In my experience with several cases in which the gastric analyses would logically suggest an incontinent pylorus I have always observed that hypermotility of the organ accounted for the emptiness.

Of the symptoms described there are those of gastric distress of no definite type, constipation, insomnia, abdominal distention and neurasthenic symptoms. The diagnosis is suggested by finding an empty stomach soon after eating, with bile present in the full as well as the empty organ. On inflation it is said that the air rushes into the intestine, causing a quick general tympany, while that of the stomach soon disappears. I agree with Ewald and Einhorn in that this is a fallacious method of examination. Even in cases of marked atony and dilatation, air begins rushing into the duodenum within a few moments after its introduction or generation within the organ. In other cases, again, even in extreme distention, retention in the stomach is marked and persistent. It has often occurred to me that the quicker and the greater the stomach is distended, the less is the liability that the air will quickly escape. It seems as if the extreme distention causes a closure of both sphincters, a condition that could not exist in pyloric incontinence. In four cases in which the findings of rapid evacuation and constant presence of bile in the organ would lead one to the diagnosis of pyloric incontinence, in each instance I have observed hypermotility was successful in obtaining sufficiently sharp radiographs to show the pyloric grooves above and below (closed pylorus), and was able to distend the stomach so that quick escape was not noted; therefore, I have looked upon these as instances of hypermotility of the externally invisible form. So it is that one should be careful in making the diagnosis from only moderate inflation and test-meal extractions without further examination. Furthermore, the presence of bile and pancreatic secretions in the stomach, whether fasting or full, or when the secretions are observed in the lavage water, are most common findings in other cases,

even those in which delay of the exit of food for no obstructive reason may be observed.

The treatments that have been advised are the use of finely subdivided solid foods, frequent small meals, intragastric faradism, strychnine, postural treatments, and that for neurasthenia.

#### DUODENAL REGURGITATION DUE TO FATTY FOODS.

Recently the author has drawn attention to a condition giving marked gastric symptoms due to the taking of fatty foods and oils.<sup>1</sup> The condition may be referred to as a clinical entity, probably without pathology, and is of importance because of the general employment of oils and fat-bearing foods in the treatment of gastric disorders. Up to the present time, the cases in which the use of the fats or oils are contraindicated are those of so-called fat intolerance in which poor fat digestion and absorption and a difficulty to assimilate fats after absorption are present. There is, however, a stomach condition in which such fat foods as milk, fresh cream, butter and eggs, and the native oils are distinctly harmful to employ in a diet and responsible for the establishment of the condition in the first instance, and for its perpetuation afterward should their employment be continued.

The main symptom in these cases is a sharp onset of acute gastric pains, radiating to the back, which come on in paroxysms, persisting for from several minutes to several hours and sometimes over days at a time. The pains may be severe enough to incapacitate the patient for the time being, and when absent, which may occur suddenly, the individual is as well as ever. The gastric distress is independent of meals and the ingestion of any particular kinds of ordinary foods. Occasionally, nausea is present during the seizures, but not vomiting. The condition occurs in the middle aged, and the physical examination of the stomach and abdomen is negative. More or less general distress from anxiety and suffering is present when the pain is on.

The gastric analyses show a large return after an Ewald meal, in one of my cases being 900 cubic centimeters in amount. This is deeply bile stained, contains considerable floating fat, fatty acids, much pancreatic juice, hydrochloric acid in large amounts, and perhaps mucus from stomach irritation. The empty stomach, aspirated even in the mornings, shows a large accumulation of duodenal secretions, fat and fatty acids, mucus, and perhaps small amounts of hydrochloric acid, the entire return in one of my cases amounting to 73 cubic centimeters. During the paroxysm of pain the stomach invariably contains the above accumulation, it being not so or very

much less so when the patient is pain free or when established on a fat-free diet for several days.

In the production of the condition it is important to recall that Pawlow in his experiments upon dogs having a gastric fistula obtained an emulsion which contained bile and pancreatic juice one or two hours after the ingestion of oil. Volhard, following Boldyreff, noted that in the human stomach positive results in the way of obtaining regurgitated fluid containing trypsin following the taking of an oil were successful in 60 per cent. of cases. Upon these observations the Levinsky method (giving half a teaspoonful of magnesia usta twenty minutes before the oil and another twenty minutes afterward to neutralize the acidity of the stomach contents), and the Kozickowsky method (using cream instead of plain oil) for obtaining specimens of duodenal secretions from the stomach following the giving of an oil were based; and I may state that the latter two methods are quite as practicable for obtaining specimens of duodenal secretions for examination as the two recently advanced mechanical means.

The condition is probably brought about by the normal pyloric reflex being interfered with, permitting of regurgitation, either by there being a diminished secretion of hydrochloric acid (which, according to Cannon, activates this reflex by stimulation of the duodenal mucosa by the fats and oils) or, as seems more likely, by the fatty foods or oils in some way directly affecting the mucosa of the pyloric region of the stomach and the pyloric muscle and causing relaxation or otherwise permitting of regurgitation. The pains in these cases are due to a collecting of the regurgitated juice in the stomach, resulting in the formation of the fatty acids from the oils and fats, and these with the bile irritating the stomach. These cases rapidly recover when a fat-free diet (skimmed milk, white of eggs, carbohydrates, green vegetables, salads, boiled meats, etc.) is instituted without any further forms of treatment. The condition must be diagnosed from those instances of test-meal extractions in which bile is noted in the stomach (these test-meals contain only small amounts and are usually of no practical importance), from gastrosuccorrhea (in which the pains are not so severe, no duodenal secretions are present and if so only in small amounts, and the mucous content is lower and the hydrochloric acid is higher), and pylorospasm. The best means for differentiation as well as diagnosis of the condition is gastric analyses, and the diagnosis should not be made unless the patient has taken these foods and the characteristic findings in the test-meal extractions and the aspiration from the fasting stomach are detectable.

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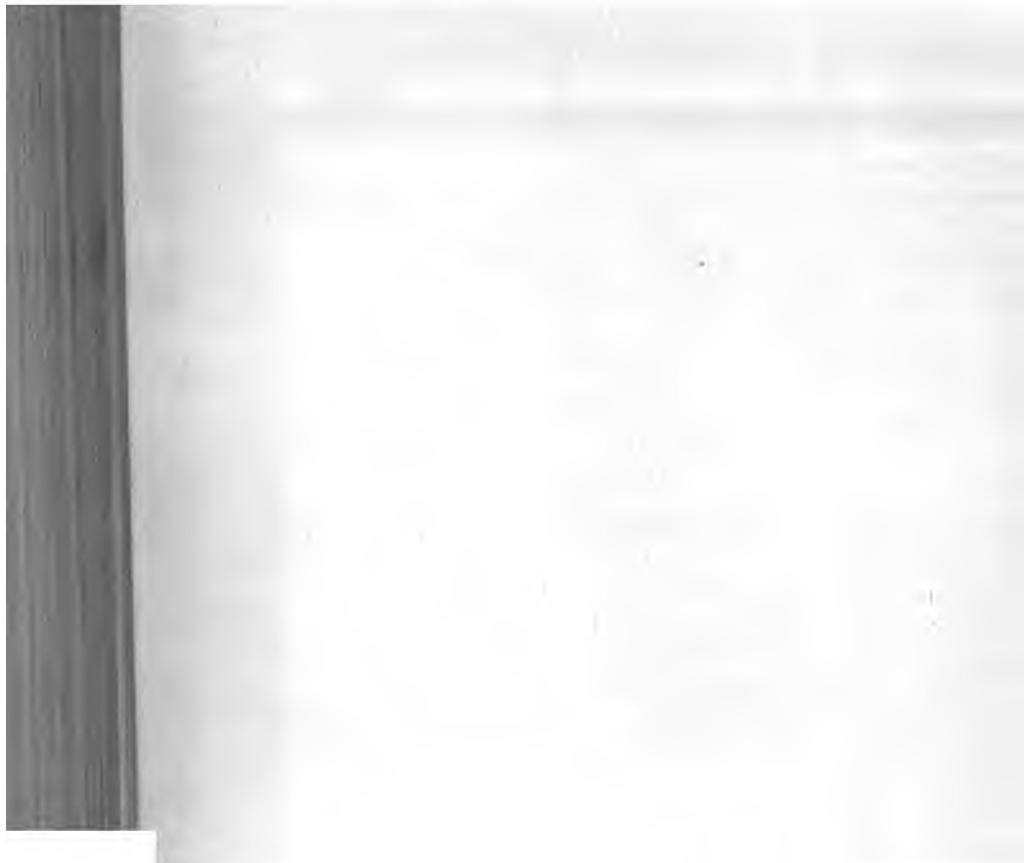
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